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13. ABSTRACT (Maximum 200 words) A Site Investigation (SI) was conducted as part of the Installation Restoration Program (IRP) for the 181st Fighter Group of the Indiana Air National Guard, Hulman Field Municipal Airport (MAP), Terre Haute, IN. Six Sites were investigated to obtain data to confirm the presence or absence of environmental contamination, to perform limited quantification of contamination if found, and to assess resulting human health and environmental risks. At five sites, although various contaminants (volatile organic compounds, polyaromatic hydrocarbon compounds, metals, and petroleum hydrocarbons) were detected, none were in sufficient concentration to cause adverse non-carcinogenic health effects and the cancer risk estimate is below the U.S. EPA target range. Hence no further action is recommended at those sites. At the sixth site nickel, chromium and lead were detected in concentrations which exceeded promulgated Federal and State standards for groundwater. Also this site is an area of high foot traffic. It is recommended that a specified grassy area be covered with concrete to help mitigate the potential for future transport of contaminants to subsurface soils and groundwater from surface runoff.			
14. SUBJECT TERMS IRP (Installation Restoration Program), CEVR, ANGRG(Air National Guard Readiness Center), SI(Site Investigation Report), 181st Fighter Group, Hulman MAP, Terre Haute, Indiana		15. NUMBER OF PAGES 314 + 310 = 624	
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# INSTALLATION RESTORATION PROGRAM

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## FINAL SITE INVESTIGATION REPORT

181<sup>ST</sup> FIGHTER GROUP  
INDIANA AIR NATIONAL GUARD  
HULMAN MUNICIPAL AIRPORT  
TERRE HAUTE, INDIANA

VOLUME II

JANUARY 1995



HAZARDOUS WASTE REMEDIAL ACTIONS PROGRAM  
Environmental Restoration and Waste Management Programs  
Oak Ridge, Tennessee 37831-7606  
managed by MARTIN MARIETTA ENERGY SYSTEMS, INC.  
for the U.S. DEPARTMENT OF ENERGY under contract DE-AC05-84OR21400

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**AIR NATIONAL GUARD**  
**INSTALLATION RESTORATION PROGRAM**

**FINAL**  
**SITE INVESTIGATION REPORT**  
**VOLUME II**

**181st Fighter Group**  
**INDIANA AIR NATIONAL GUARD**  
**Hulman MAP**  
**Terre Haute, IN**  
Task Order Authorization No. Y-01  
Contract No. 43B-99791C

Submitted to:

**AIR NATIONAL GUARD READINESS CENTER**  
**ANDREWS AIR FORCE BASE, MARYLAND**

Submitted by:

**HAZARDOUS WASTE REMEDIAL ACTION PROGRAM**  
**MARTIN MARIETTA ENERGY SYSTEMS, INC.**

Prepared by:

**METCALF & EDDY, INC.**  
30 Harvard Mill Square  
Wakefield, MA 01880

January 1995



APPENDIX A	Boring Logs
APPENDIX B	Piezometer/Monitoring Well Construction Diagrams
APPENDIX C	Survey Data and Slug Test Calculations
APPENDIX D	Piezometer/Monitoring Well Development and Sampling Worksheets
APPENDIX E	Piezometric Surface and Till Contours
APPENDIX F	Quality Control Data & Validation
APPENDIX G	Toxicity Profiles
APPENDIX H	1986 Analytical and Field Data From Site 4

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By	
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Availability Codes	
Dist	Avail and/or Special
A-1	

**APPENDIX A**  
**Boring Logs**

### **BORING LOG LEGEND**

NO.	Sample Identification Number
SS -	Split Spoon Sampler
BC/6" -	Blow Count per 6 inch advance (ASTM D 1586)
REC -	% Sample Recovery in Sampling Device
(7YR6/4)	Color Code from Munsell Color Chart

LOCATION: HULMAN ANG; NE of Trailer 94  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-27-90  
 GEOLOGIST: T. Francy

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	3/6	90	- Silty loam (TOP SOIL), brown to yellow brown with rootlets, dry	HNu bkgd SS
---		SS	7/8			
---		SS	3/5	70	-Silty CLAY (CL) to very clayey SILT, mottled gray and yellow brown, black mineral stains and concretions, moist, becomes wet at 5'	HNu bkgd SS
---		SS	6/8			
- 5 -		SS	1/2	90		No Sample
---		SS	3/3			
---		SS	2/2			
---		SS	3/4			
- 10 -					-As above.	HNu 0.6ppm SS
---		SS	2/2	95		
---		SS	3/3			
---						
- 15 -		SS	2/2		-Silt, to fine sand with pebbles (TILL), medium to dense, trace organic matter, wet, becomes dry at 20'.	HNu 0.2ppm SS
---		SS	25/32			
---		SS	15/40	60	Total Depth=20.1 FT	
- 20 -		SS	50(4")			
---						
---						
---						
---						
- 25 -						
---						
---						
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---						
- 30 -						
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---						
- 35 -						
---						
---						
---						
- 40 -						

AU -in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING P-1

LOCATION: HULMAN ANG; P-2  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-30-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	6/10	70	-Clayey Loam (TOP SOIL), brown to yellow brown, stiff.	HNu= 0.6ppm SS  HNu= 0.4ppm SS  HNu= 0.4ppm SS
---		SS	9/7			
---		SS	4/4	70	-Silty CLAY (CL), brown, mottled, black mineral stains, stiff, plastic, moist.	
---		SS	6/6			
- 5 -		SS	2/3	90	-As above, trace fine sand	
---		SS	4/3			
---		SS	1/2	100	-Sandy CLAY (CL), brown, stiff, plastic, moist angular, increasing sand with depth.	
---		SS	3/4			
---		SS	2/3	100		
- 10 -		SS	3/5			
---		SS	1/2	60	-SAND (SP) to 14.5' medium to fine grained, with pebbles, trace clay, becomes more clayey with depth, moist.	
---		SS	3/5			
---		SS	4/4	80		
---		SS	6/4			
- 15 -		SS	3/7	100	-Silty CLAY (CL), brown to 15', moist.	
---		SS	15/7		-Silt to fine sand with pebbles (TILL), gray, hard, dry.	
---						
---						
---						
- 20 -					-Total Depth = 20.2 FT	
---						
---						
---						
---						
- 25 -						
---						
---						
---						
---						
- 30 -						
---						
---						
---						
---						
- 35 -						
---						
---						
---						
---						
- 40 -						

AU – in auger

BZ – in breathing zone

SS – split spoon sample

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING P-2

LOCATION: HULMAN ANG; Next to Jetway  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-27-90  
 GEOLOGIST: T. Francy

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---					No samples collected 0–15 feet.	HNu= 0.0 ppm SS
---						
---						
---						
- 5 -						
---						
---						
---						
- 10 -						
---						
---						
---						
- 15 -						
---		SS	1/3	85	–CLAY (CL), brown to yellow, grades to silty clay with some sand and organic matter, moist.	HNu= 0.0 ppm SS HNu= 0.0 ppm SS HNu= 0.0 ppm SS
---		SS	6/4			
---						
---		SS	15/20	80	– TILL, fine, some clay and silt, trace gravel, moist.	
- 20 -		SS	30/34			
---					–Total Depth = 20.2 FT.	
---						
---						
---						
- 25 -						
---						
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- 30 -						
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---						
- 35 -						
---						
---						
---						
- 40 -						
					AU – in auger BZ – in breathing zone SS – split spoon sample	

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING P-3

LOCATION: HULMAN ANG; P-4  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-26-90  
 GEOLOGIST: T. Francy

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	3/4	50	-clayey, SILT, gray to yellow brown, with roots.	
---		SS	5/5			
---		SS	2/4	75	-Silty CLAY (CL), gray to yellow brown, moist. Increasing silt with depth.	HNu= bkgd
---		SS	4/6			
- 5 -		SS	2/2	80	-As above, wet	HNu= bkgd
---		SS	3/4			
---		SS	1/2			HNu= bkgd
---		SS	2/3			
---						
- 10 -						
---		SS	2/2	85		HNu= bkgd
---		SS	2/3			
---						
- 15 -						
---		SS	2/3	80	-Clay, with sand, silt and gravel (TILL), very dense, wet.	
---		SS	20/20			
---					-As above, dry. -Total Depth = 20 FT	
- 20 -		SS	49/50 (2")	10"		
---						
---						
---						
- 25 -						
---						
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---						
- 30 -						
---						
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---						
- 35 -						
---						
---						
---						
- 40 -						

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING P-4

LOCATION: P-5  
DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-29-90  
GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	4/9	60	-Silt and clay loam (TOP SOIL), damp.	
---		SS	13/17			
---		SS	6/4	80	-Silty CLAY (CL), brown, stiff, dry.	HNu= bkgd SS
---		SS	6/9			
- 5 -		SS	2/2	100		
---		SS	2/2			
---		SS	1/1	95		
---		SS	2/3			
---		SS	1/2	100	-Silty CLAY (CL), gray, trace fine to medium sand, stiff, increasing sand with depth, moist.	HNu = bkgd SS
- 10 -		SS	3/4			
---		SS	1/2	90		
---		SS	2/3			
---						
---						
- 15 -						
---		SS	3/6	70	-Sandy Clay (TILL) with small pebbles, wet, firm.	HNu= bkgd SS
---		SS	9/10			
---						
---						
---		SS	20/50	80	-As above, dry	
- 20 -		SS	(4")		Total Depth = 20.1 FT.	
---						
---						
---						
---						
- 25 -						
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- 30 -						
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---						
- 35 -						
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---						
---						
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- 40 -						

AU - in auger  
BZ - in breathing zone  
SS - split spoon sample

## LOG OF BORING P-5



LOCATION: HULMAN ANG; NW of Bldg 26  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-28-90  
 GEOLOGIST: T. Francy

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	6/8	80	-Silt and Clay (TOP SOIL), brown to gray, mottled at 1', slightly moist. -Silty CLAY (CL), gray to yellow brown, mottled, locally abundant concretions and black stains, moist. -Clayey SILT (ML), becomes wet, soft. -becomes very clayey, gray to yellow brown, with iron concretions, wet.	HNu= bkgd SS
---		SS	8/10			
---		SS	6/8	80		
---		SS	11/10			HNu= bkgd SS
- 5 -		SS	2/2	85		
---		SS	2/4			HNu= bkgd SS
---		SS	2/2	100		
---		SS	4/5			HNu= 0.1ppm SS
---		SS	2/2	100		
- 10 -		SS	4/4			
---		SS	1/1	90		
---		SS	2/2			
---					-Silt and clay (TILL), gray with sand and trace gravel, dense, 45 degree fracture, dry at 16.5'. -Total Depth = 19.8 FT.	
---						
- 15 -						
---		SS	4/24	60		
---		SS	50(4")			
---						
---		SS	27/50			
- 20 -		SS	(5")			
---						
---						
- 25 -						
---					AU - in auger BZ - in breathing zone SS - split spoon sample	
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- 30 -						
---						
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---						
- 35 -						
---						
---						
- 40 -						

## LOG OF BORING P-6

LOCATION: HULMAN ANG, 2' NW of Site  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-29-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	9/33	0	-No recovery, rock in spoon.	HNu= 0.0 ppm SS
---		SS	9/3			HNu= 0.0 ppm SS
---		SS	3/3	90	-Silty CLAY (CL) black, mottled brown, moist	HNu= 0.0 ppm SS
---		SS	5/7			
- 5 -		SS	4/4	100	-As above, trace fine sand.	HNu= 0.0 ppm SS
---		SS	4/5			
---		SS	1/1	100	-Silty CLAY (CL), brown with black mineral stains, weathered horizon at 7.5', small rocks	
---		SS	3/4			
---		SS	1/1	80	present, some sand, moist.	HNu= 0.1 ppm SS
- 10 -		SS	1/2			
---		SS	1/1	70	-Sandy CLAY (CL), grey, abrupt contact, wet at 11.5'.	
---		SS	1/3			
---						
---						
- 15 -						HNu= 0.1 ppm SS
---		SS	12/20	80	-TILL, interbedded sand and sandy clays, discontinuous, trace pebbles, wet.	
---		SS	32/27			
---						HNu= 0.4 ppm SS
---		SS	26/50	100	-As above, no pebbles.	
- 20 -		SS	(4")		- Clayey Sand, grey, firm to stiff at 18.5'.	
---						
---						
---						
---						
- 25 -						
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---						
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- 30 -						
---						
---						
---						
---						
- 35 -						
---						
---						
---						
---						
- 40 -						

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING P-7

LOCATION: HULMAN ANG, 36' from Taxiway  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 9-28-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	4/7	70	-TOP SOIL, light brown, trace pebbles, dry.	HNu= 0.0 ppm SS
---		SS	9/1			HNu= 0.0 ppm SS
---		SS	2/4	70	-Silty CLAY (CL), brown, black mottling, some mineral stains, moist.	
---		SS	6/8			
- 5 -		SS	1/2	75	-As above, becomes grey, at 5.5', mottled, moist, trace sand and silt from 6-8'.	HNu= 0.0 ppm SS
---		SS	2/3			HNu= 0.0 ppm SS
---		SS	2/2	95		
---		SS	4/5			
---		SS	1/2	80	-Clayey SAND (SC), medium grained, grey with brown mottling, some silt, moist, water encountered at 11'.	
- 10 -		SS	2/3			HNu= 0.0 ppm SS
---		SS	1/2	75		
---		SS	2/3			
---						
---						
- 15 -						HNu= 0.0 ppm SS
---		SS	2/2	70		
---		SS	3/1		-TILL, Silty Sand (SM), grey, trace cobbles,	
---						
---		SS	12/13	80		
- 20 -		SS	12/9			HNu= 0.0 ppm SS
---					-Total Depth = 20.3 Ft.	
---						
---						
---						
- 25 -						
---						
---						
---						
- 30 -						
---						
---						
---					AU - in auger BZ - in breathing zone SS - split spoon sampling	
- 35 -						
---						
---						
- 40 -						

## LOG OF BORING P-8

LOCATION: HULMAN ANG, Background Area.  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-11-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	10/20	100	-Silty CLAY (CL), brown (7.5YR5/4), moist.	HNu= 0.0 ppm SS
---		SS	20/21			HNu= 0.0 ppm SS
---		SS	7/9		CALIFORNIA SPLIT SPOON, SAMPLES NOT LITHOLOGICALLY LOGGED.	
---		SS	9/7			
- 5 -		SS	6/6			HNu= 0.0 ppm SS
---		SS	6/8			
---		SS	1/1	90	-Sandy SILT (ML), brown (7YR6/4), mottled, wet.	
---		SS	1/2			
---						
- 10 -						HNu= 0.0 ppm SS
---		SS	1/1	90	-Fine SAND (SP), light brown (7YR6/4), mottled, some clay, plastic, wet.	
---		SS				
---						
- 15 -						
---		SS	10/25		-TILL encountered at 15.5', grey, trace pebbles, dry.	
---		SS	41/50			
---			(4")			
---		SS	12/13	80		
- 20 -		SS	12/9			
---					Total Depth = 20 feet.	
---						
---						
- 25 -						
---						
---						
---						
- 30 -						
---						
---						
---						
- 35 -						
---						
---						
---						
---						
- 40 -						

AU - in auger  
 BZ - in breathing zone  
 SS- split spoon sample

## LOG OF BORING BHB-01

LOCATION: HULMAN ANG, BH5-02  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-12-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	10/20		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 1-7 feet.	HNu=3.0 ppm AU
---		SS	22/25			HNu=0.0 ppm BZ
---		SS	6/7			OVA=1 ppm SS
---		SS	9/12			OVA=5 ppm SS
- 5 -		SS	4/6			OVA=3 ppm SS
---		SS	6/6			
---					-SAND (SP), brown to gray, mottled and wet	HNu=3.2 ppm AU HNu=0.0 ppm BZ OVA= <0.1 ppm SS
---						
- 10 -						
---		SS				
---		SS			-SAND (SP), fine to medium grained, clay. Dry TILL at 16.5 feet, hard, pebbles	HNu= 0.0 ppm SS OVA= <0.1 ppm SS
---						
- 15 -						
---		SS		80		
---		SS			Total depth = 17 feet.	
---						
- 20 -						
---						
---						
---						
- 25 -						
---						
---						
---						
- 30 -						
---						
---						
---						
- 35 -						
---						
---						
---						
- 40 -						

AU - in augers  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING BH5-02

LOCATION: HULMAN ANG, BH5-03  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-12-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS			CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED (1-7 ft)	HNu= 0.0 ppm SS
---		SS	9/15			OVA= 0.2 ppm SS
---		SS	17/25			
---		SS	7/8			HNu= 0.0 ppm SS
- 5 -		SS	9/11			OVA< 0.1 ppm SS
---		SS	4/6			HNu= 5.0 ppm AU
---		SS	8/8			HNu= 0.0 ppm BZ
---						OVA= 6.0 ppm SS
- 10 -						HNu= 0.0 ppm SS
---		SS	2/2	100	-SAND (SP), fine to medium grained, trace clay, brown gray, moist.	OVA< 0.1 ppm SS
---		SS	3/11			
---						
- 15 -						HNu= 0.0 ppm SS
---		SS	1/2		-SAND (SP), medium grained, light brown (5YR5/6), massive, wet.	OVA< 0.1 ppm SS
---		SS	2/4			
---						
- 20 -		SS	30/50 (6")		TILL, massive, dense, subangular pebbles, dry.	
---						
---						
---						
- 25 -						
---						
---						
---						
- 30 -						
---						
---						
---						
- 35 -						
---						
---						
---						
- 40 -						

Total depth = 20 feet.

AU - in augers  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING BH5-03

LOCATION: HULMAN ANG, BH6-04  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-15-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	15/20		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 2.5 ppm SS
---		SS	20/20			HNu= 7.0 ppm AU
---		SS	8/15			HNu= 0.0 ppm BZ
---		SS	16/14			OVA= 7 ppm SS
- 5 -		SS	5/7			HNu= 7.0 ppm AU
---		SS	8/10			HNu= 0.0 ppm BZ
---						OVA= 8 ppm SS
---						
- 10 -						HNu= 0.1 ppm SS
---		SS	1/2		-SAND (SP) gray, mottled brown, some pebbles, wet.	OVA= .2 ppm SS
---		SS	2/4			
---						
---						
- 15 -						
---		SS	2/3		-As above -TILL at 16.7 feet.	HNu= 0.0 ppm SS
---		SS	7/12			OVA= 0.3 pp SS
---						
- 20 -					Total Depth = 17 feet.	
---						
---						
---						
---						
---						
- 25 -						
---						
---						
---						
- 30 -						
---						
---						
---						
- 35 -						
---						
---						
---						
- 40 -						

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING BH6-04

LOCATION: HULMAN ANG, BH6-05  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-15-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	8/10		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 80 ppm SS
---		SS	12/15			
---		SS	8/10			OVA= 40 ppm SS
---		SS	11/12			
- 5 -		SS	2/5			OVA= 6 ppm SS
---		SS	6/8			
---						
---						
- 10 -						OVA= 0.2 ppm SS
---		SS	1/2		SAND (SP) fine to medium, and CLAY (CL), mottled brown and gray, no pebbles, wet.	
---		SS	3/3			
---						
---						
- 15 -						OVA= 0.2 ppm SS
---		SS	25/31		-Dry TILL at 15 feet, brown, becomes gray, sand, pebbles and clay.	
---		SS				
---						
- 20 -					Total Depth = 17 feet.	
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- 25 -						
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- 30 -						
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- 35 -						
---						
---						
---					AU - in auger	
---					BZ - in breathing zone	
- 40 -					SS - split spoon sample	

LOG OF BORING BH6-05



LOCATION: HULMAN ANG, BH2-06  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-13-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	5/11		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 0.4 ppm SS
---		SS	13/20			
---		SS	5/4			HNu= 0.1ppm SS
---		SS	6/6			OVA= 2.5 ppm SS
- 5 -		SS				HNu= 0.0ppm SS
---		SS				OVA= 9.0 ppm SS
---						
---						
- 10 -						HNu= 0.0ppm SS
---		SS	2/3		-SAND (SP), fine to medium grained, gray, some clay, moist, few pebbles.	OVA= 1.0 ppm SS
---		SS	4/5			
---						
---						
- 15 -						OVA= 0.6 ppm SS
---		SS	2/4		As above.	
---		SS	5/7		-TILL, at 17.5 feet, massive sand, gray, little clay, wet.	
---					Total Depth = 17.5 feet.	
- 20 -						
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- 25 -						
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- 30 -						
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- 35 -						
---						
---						
---						
- 40 -						

AU - in augers  
 BZ - in breathin zone  
 SS - split spoon sample

## LOG OF BORING BH2-06

LOCATION: HULMAN ANG, BH2-07  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-13-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	3/10		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	HNU= 0.0 ppm SS
---		SS	11/14			OVA= 4.2 ppm SS
---		SS	11/13			HNU= 10.0 ppm AU
---		SS	13/16			HNU= 0.0 ppm BZ
- 5 -		SS	2/3			OVA= 12 ppm SS
---		SS	7/8			OVA= 4.0 ppm SS
---					-SAND (SP), medium grained, gray, mottled brown, wet.	
---						
- 10 -						HNU= 1.5 ppm AU
---		SS	1/2	100		HNU= 0.0 ppm BZ
---		SS	3/5		-SAND (SM), coarse grained, unconsolidated, wet. TILL, @ 17 ft.	OVA= 3.8 ppm SS
---						
---						
- 15 -						HNU= 0.5 ppm SS
---		SS	1/1		Total Depth = 17 feet.	OVA= 3.8 ppm SS
---		SS	9/4			
---						
---						
- 20 -						
---						
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- 25 -						
---						
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---						
- 30 -						
---						
---						
- 35 -					AU - in auger BZ - in breathing zone SS - split spoon sample	
---						
---						
- 40 -						

## LOG OF BORING BH2-07

LOCATION: HULMAN ANG, BH2-08  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-13-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	3/11		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	HNu= 0.0 ppm SS
---		SS	15/17			OVA= 3.5 ppm SS
---		SS	6/9			
---		SS	15/17			OVA= 3.0 ppm SS
- 5 -		SS	3/6			HNu= 0.0 ppm SS
---		SS	9/9			OVA= 1.6 ppm SS
---						
---						
- 10 -						HNu= 0.0 ppm SS
---		SS	1/2	100	-SAND (SP), medium to fine grained brown gray, mottled, plastic, moist.	OVA= 0.6 ppm SS
---		SS	3/5			
---						
---						
- 15 -						HNu= 0.1 ppm SS
---		SS	6/10		-SAND (SP), medium grained, brown grey mottled, wet. Dry TILL at 16.4 ft., grey, hard	OVA= 0.2 ppm SS
---		SS	11/11			
---					Total Depth = 17 feet.	
- 20 -						
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- 25 -						
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- 30 -						
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- 35 -						
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---						
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- 40 -						

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF BORING BH2-08

LOCATION: HULMAN ANG, BH2-09  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-13-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	16/18		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA = 1.2 ppm SS
---		SS	25/18			HNu = 3.0 ppm AU
---		SS	8/13			HNu = 0.0 ppm BZ
---		SS	15/21			OVA= 12 ppm SS
- 5 -		SS	2/5			HNu = 0.0 ppm SS
---		SS	10/11			OVA= 2.0 ppm SS
---						
---						
- 10 -						HNu = 1.0 ppm AU
---		SS		100	-Clayey SILT (ML), gray, stiff, plastic, trace medium grained dark gray sand, moist.	OVA= 0.3 ppm SS
---		SS				
---						
---						
- 15 -						HNu = 3.0 ppm AU
---		SS	9/10		-SAND (SP), coarse grained, gray, some pebbles, wet. Dry TILL, at 17 ft., hard.	HNu = 0.0 ppm BZ
---		SS	10/12			OVA= 0.6 ppm SS
---						
---					Total Depth = 17 feet.	
- 20 -						
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- 25 -						
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- 30 -						
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- 35 -						
---						
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- 40 -						

AU - in auger  
 BZ - in breathin zone  
 SS - split spoon sample

## LOG OF BORING BH2-09

LOCATION: HULMAN ANG, BH4-10  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-14-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	5/15		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	HNu= 0.0 ppm SS
---		SS	17/30			OVA= 1.0 ppm SS
---		SS	7/9			OVA= 4.0 ppm SS
---		SS	11/30			HNu= 0.0 ppm SS
- 5 -		SS	4/8			OVA= 6.0 ppm SS
---		SS	5/10			
---						
---						
- 10 -						
---		SS		90	-SAND (SP), medium grained, gray brown, some clay, very moist.	OVA= 0.5 ppm SS
---		SS				
---						
---						
- 15 -						
---		SS	1/3		-As above, wet.	HNu = 0.0 ppm SS
---		SS	5/15		-TILL, at 16.5 feet, gray, hard, dry.	OVA = 0.6 ppm SS
---						
---					Total Depth = 17 feet.	
- 20 -						
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- 25 -						
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- 30 -						
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- 35 -						
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- 40 -						

LOG OF BORING BH4-10

LOCATION: HULMAN ANG, BH4-11  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-14-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	4/7		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 0.4 ppm SS
---		SS	15/32			HNu= 1.0 ppm AU
---		SS	7/10			HNu= 0.0 ppm BZ
---		SS	13/14			OVA= 10.0 ppm SS
- 5 -		SS	3/6			HNu= 0.0 ppm SS
---		SS	6/9			OVA= 8.0 ppm SS
---					-SAND (SP), medium grained, gray brown, some clay, very moist, few pebbles.	
---						
- 10 -						
---		SS	4/4	100		HNu =0.0 ppm SS
---		SS	5/9		As above, wet. -TILL, at 16.5 feet, gray, hard, massive, dry.	OVA= 0.4 ppm SS
---						
- 15 -						
---		SS	1/3			HNu =0.0 ppm SS
---		SS	5/15		Total Depth = 17.5 feet.	OVA= 0.2 ppm SS
---						
- 20 -						
---						
---						
- 25 -						
---						
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- 30 -						
---						
- 35 -					AU - in auger BZ - in breathing zone SS - split spoon sample	
---						
---						
- 40 -						

## LOG OF BORING BH4-11

LOCATION: HULMAN ANG, BH4-12  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-14-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	3/6		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	HNu= 0.0 ppm SS
---		SS	7/11			OVA= 0.0 ppm SS
---		SS	6/11			HNu= 0.0 ppm SS
---		SS	13/17			OVA= 2.0 ppm SS
- 5 -		SS	3/6		Saturated	OVA= 1.8 ppm SS
---		SS	6/9			
---						
---						
- 10 -					-SAND (SP), brown, mottled, wet.	OVA= 0.2 ppm SS
---		SS	2/2			
---		SS	2/4			
---						
- 15 -					-SAND (SP), medium grained, gray, few pebbles, wet.	OVA= 0.2 ppm SS
---		SS	2/4			
---		SS	6/16			
---						
- 20 -					TILL, at 16 feet, light gray, hard, dense, pebbles, little sand and clay, dry.	
---					Total Depth = 17 feet.	
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- 25 -						
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- 30 -						
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- 35 -						
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- 40 -					AU - in auger BZ - in breathing zone SS - split spoon sample	

## LOG OF BORING BH4-12

LOCATION: HULMAN ANG, BH4-13  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-14-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	6/11		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	OVA= 0.6 ppm SS
---		SS	10/9			
---		SS	6/11			HNu= 0.0 ppm SS
---		SS	12/18			OVA= 6 ppm SS
- 5 -		SS	1/4			HNu= 0.4 ppm SS
---		SS	6/8			OVA= 2.2 ppm SS
---						
---						
- 10 -						
---		SS	2/2		-SAND (SP), brown, medium grained, mottled, wet.	OVA< 0.1 ppm SS
---		SS	3/3			
---						
---						
- 15 -						
---		SS	4/5		-SAND (SP), gray, unconsolidated, few pebbles, wet.	HNu= 0.2 ppm SS
---		SS	6/13			
---					-TILL, at 16.5 feet, light gray, hard, dense, pebbles, little sand and clay, dry.  Total Depth = 17 feet.	OVA= 0.4 ppm SS
- 20 -						
---						
---						
---						
- 25 -						
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- 30 -						
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- 35 -					AU - in auger BZ - in breathing zone SS - split spoon sample	
---						
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- 40 -						

## LOG OF BORING BH4-13



LOCATION: HULMAN ANG, BH1-14  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-15-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	10/15		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED. 0-6 feet.	HNu= 0.0 ppm SS OVA= 1.5 ppm SS OVA= 2 ppm SS
---		SS	27/25			
---		SS	4/17			
---		SS	17/19			
- 5 -		SS	3/6		-SAND (SP), fine to medium grained, grey with brown mottles, some clay, wet.	HNu= 0.1 ppm SS OVA= 2.4 ppm SS
---		SS	8/9			
---						
---						
- 10 -					-TILL, at 15 feet, gray, hard, some sand, dry.	HNu= 0.0 ppm SS OVA= 0.8 ppm SS
---		SS	1/2	100		
---		SS	2/4			
---						
- 15 -					Total Depth = 17 feet.	HNu= 0.0 ppm SS OVA= 0.2 ppm SS
---		SS	25/31			
---		SS	50(1")			
---						
- 20 -					AU - in auger BZ - in breathing zone SS - split spoon sample	
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- 25 -						
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- 30 -						
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- 35 -						
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- 40 -						

LOG OF BORING BH1-14

LOCATION: HULMAN ANG, Site 1 north of Taxiway.  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-15-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	15/22		CALIFORNIA SPLIT SPOON, SAMPLES NOT LOGGED.	OVA= 0.4 ppm SS
---		SS	20/20			HNu= 0.0 ppm SS
---		SS	5/6			OVA= 1.0 ppm SS
---		SS	7/8			HNu= 0.0 ppm SS
- 5 -		SS	4/5			OVA= 6.0 ppm SS
---		SS	5/6			
---						
---						
- 10 -						HNu= 0.0 ppm SS
---		SS			-SAND (SP), fine to medium grained, gray with brown mottles, some clay, wet.	OVA= 0.2 ppm SS
---		SS				
---						
---						
- 15 -						OVA= 0.2 ppm SS
---		SS			-As above	
---		SS			-TILL at 16 feet, moist, soft, sand, clay and pebbles.	
---						
- 20 -					Total Depth = 17 feet.	
---						
---						
---						
- 25 -						
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- 30 -						
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- 35 -						
---						
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---						
- 40 -					AU - in auger BZ - in breathing zone SS - split spoon sample	

## LOG OF BORING BH1-15

LOCATION: HULMAN ANG, SW of Site 1.  
DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-16-90  
GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	8/8	70	-Silty CLAY, gray (10YR7/1) and yellow brown (10YR6/8 to 5/8), mineral stains, dry.	HNu= 0.0 ppm SS
---		SS	9/10			
---		SS	3/3	75	-Clayey SILT, gray (10YR7/1) with yellow brown (10YR6/8) mottles, moist.	HNu= 0.0 ppm SS
---		SS	4/5			
- 5 -		SS	1/2	80	-As above, moist to wet	
---		SS	3/4			
---						
---						
- 10 -						HNu= 0.1 ppm SS HNu= 0.0 ppm SS
---		SS	1/1	80		
---		SS	2/4		-Clayey SILT, gray (As Above) and yellow brown (As Above) trace fine to medium sand, Fe concretions.	
---						
- 15 -						
---		SS	9/17	90		
---			50(5")		-TILL, brown (5Y4/3 to 4/4) and gray (10YR6/1 to 5/1), clay with silt, sand, fine to medium gravel, dense, becomes sandy at 16 feet.	
---						
- 20 -					Total depth = 20.1 feet.	
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- 25 -						
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- 30 -						
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- 35 -						
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---						
---						
- 40 -					AU - in auger BZ - in breathing zone SS - split spoon sample	
---						

LOG OF WELL MW1-06

DATE DRILLED: 10-17-90  
GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS				
---		SS	17/11	60	-Very clayey SILT (ML), grey, dry.	
---		SS	8/8			
---		SS	2/3	10	-Silty CLAY (CL), yellow brown to grey, moist.	
- 5 -		SS	4/5			HNu = 0.4 ppm SS
---		SS	1/2	75	-CLAY (CL) and SILT (ML), yellow brown to grey 10YR5/6 and 2.5YR7/0, becomes dark grey 7.5YRN4/0 at 6.5', with calcareous nodules, moist to wet.	
---		SS	3/3			
---		SS				
- 10 -		SS				HNu = 0.4 ppm AU
---		SS	3/5	60	-Clayey, sandy SILT (ML), grey, with calcareous nodules, moist to wet.	HNu = 0.0 ppm BZ
---		SS	6/8			
---						
---						
- 15 -						HNu = 1.7 ppm AU
---		SS	15/25	60	-TILL, Sand (SP) with silty gravel, wet.	HNu = 0.0 ppm BZ
---		SS	50 (5")			
---					Total Depth = 20.1 feet.	
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- 20 -						
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- 25 -						
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- 30 -						
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- 35 -						
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- 40 -						

AU – in auger  
 BZ – in breathing zone  
 SS – split spoon sample

## LOG OF WELL MW2-04

LOCATION: HULMAN ANG, SW of Site 4  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-17-90  
 GEOLOGIST: T. Aebie/T. Francy

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	4/10	85	-Silty CLAY (CL) to clayey SILT (ML), gray yellow and brown, dry, roots present.	HNu= 0.0 ppm SS
---		SS	14/13			
---		SS	2/4	70	As above, mottled, with Fe and Mn stains and nodules, moist.	
---		SS	6/6			
- 5 -		SS	2/3	70	-SILT (ML) and CLAY (CL), moist.	
---		SS	4/3			
---						
---						
---						
- 10 -						
---		SS	1/2	65	-Clayey SILT (ML), gray, trace very fine sand, soft, wet.	
---		SS	3/4			
---						
---						
- 15 -						
---		SS	8/50		-TILL, silty Sand (SP) with clay, gravel, brown, moist to dry.	
---			(5")			
---					-Total depth = 20.1 feet.	
---						
- 20 -						
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- 25 -						
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- 30 -						
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- 35 -						
---						
---						
---						
---						
- 40 -						

AU – in auger

BZ – in breathing zone

SS – split spoon sample

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF WELL MW4-05

LOCATION: HULMAN ANG, SW of Site 5  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-17-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS				
---		SS	21/14	60	-FILL and ASPHALT	
---		SS	9/10		-Clayey SILT (ML), grey, dry.	
---		SS	3/9	55	-CLAY (CL) with Silt (ML), grey and yellow	
- 5 -		SS	9/11		brown, mottled, soft, moist.	
---		SS	2/3	80	-As above, iron nodules, very soft, moist to wet.	
---		SS	4/4			
---						
---						
- 10 -						
---		SS	2/3		-Clayey SILT (ML), brown to yellow brown,	
---		SS	3/3		mottled, very soft, wet.	
---						
---						
- 15 -						
---		SS	2/3	85	TILL, grey, clayey Silt (ML) with sand and	
---		SS	5/5		gravel. 16.5-17' silty Sand (SM), with gravel	
---					and cobbles.	
---		SS			-As above	
- 20 -		SS				
---					-Total Depth = 20 FT.	
---						
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---						
- 25 -						
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- 30 -						
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- 35 -						
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---						
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- 40 -						

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF WELL MW5-02

LOCATION: HULMAN ANG, SW of Site 6  
 DRILLING FIRM: ETI, B. Repinski

DATE DRILLED: 10-17-90  
 GEOLOGIST: T. Aebie

DEPTH (Ft)	SAMPLE			REC	DESCRIPTION OF STRATIGRAPHY	COMMENTS
	NO.	TYP	BC/6"			
---		SS	4/7	70	-TOP SOIL, brown 10YR4/2 to yellow brown 10YR5/6, with roots.	HNu= 0.3 ppm AU
---		SS	8/10			
---		SS	4/4	70	-Very clayey SILT (ML to MH), yellow brown 5YR6/1 to 10YR 5/1, with black mineral stains	HNu = bkgd
---		SS	7/7			
- 5 -		SS	1/2	80	2.5YR5/0, with iron nodules and stains (5YR4/4), moist.	HNu = bkgd
---		SS	4/4			
---		SS			-As above, mottled, moist to wet.	
---						
---						
- 10 -					-Clayey SILT (ML), gray to brown 10YR4/3, with trace sand, soft, wet.	HNu = bkgd
---		SS	1/1	80		
---		SS	3/3			
---						
---						
---						
- 15 -					-TILL, clayey sandy Silt (ML), gray 5Y5/1.	HNu = bkgd
---		SS	1/2	100		
---		SS	3/4		-Total Depth = 20.2 FT.	
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- 20 -						
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- 40 -						

AU - in auger  
 BZ - in breathing zone  
 SS - split spoon sample

## LOG OF WELL MW6-03

**APPENDIX B**  
**Piezometer/Monitoring Well**  
**Construction Diagrams**



<b>MONITORING WELL INSTALLATION</b>		PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. MWB-01
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 712588.6N 440367.2W		
BEGUN: 14:20 10/11/90	SUPERVISOR: T. Aebie	WELL SITE: Background Well BHB-01	WATER LEVEL DATE: DEPTH/ELEV. 10/24/90 : 2.1/585.95	
FINISHED: 18:10 10/11/90	DRILLER: B. Repinski			
REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 588.05			DEPTH (FT)	ELEV.(FT) MSL
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>TOP OF RISER CASING</p> <p>GROUT COLLAR</p> </div> <div style="text-align: center;"> <p>TOP OF FLUSH MOUNT SURFACE CASING</p> <p>LOCKED VENTILATED EXPANSION CAP</p> </div> <div style="text-align: center;"> <p>GROUND SURFACE</p> </div> </div>			0.0	588.6
<b>GENERALIZED GEOLOGIC LOG</b>			0.6	588.05
Depths	Description			
0	Silty Clay, Moist, Brown	<p>Dia: 10 inch Cover, 8 inch Skirt</p> <p>Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid</p> <p>Manufacturer: Clay and Bailey, Kansas City, MO.</p>	1.0	578.6
2		<p>Cement: TYPE II Portland Cement</p> <p>Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite</p> <p>Water: 5 - 10 gallons</p>	3.4	585.2
6	Sandy Silt, Wet, Brown, Mottled	<p>RISER CASING: Inner Dia: 2.0 inches</p> <p>Material Information: Type 304 Stainless Steel</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p>	5.4	583.2
10	Fine Sand, Some-Clay, Plastic, Wet, Light-Brown, Mottled	<p>ANNULAR SEAL</p> <p>Material Information: 1/2in. diameter bentonite pellets</p> <p>Manufacturer: Peltonite</p>	7.6	581.0
15.5	TILL: Trace-Pebbles, Dry Grey	<p>BOTTOM OF SEAL</p> <p>TOP OF SCREEN</p> <p>FILTER MATERIAL</p> <p>Quantity: 7 (50 lb.) Bags</p> <p>Material Information: 50 lb bags of uncrushed silica sand .85-.95 grade, subrounded-rounded</p> <p>Manufacturer: WAUPACA Materials, Waupaca, WI.</p>	17.8	570.8
		<p>SCREEN: Inner Dia: 2.0 inches Opening Width: .010 inches</p> <p>Material Information: Type 304 Stainless Steel Continuous Slot Well Screen</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p>	19.8	568.8
		<p>BOTTOM OF SCREEN</p> <p>BOTTOM OF SUMP</p> <p>BOTTOM OF HOLE</p>	20.0	568.6
<b>METHOD DRILLED:</b> 6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig		<b>HOLE DIAMETER:</b> <div style="display: flex; align-items: center;"> <div style="width: 20px; border-top: 1px solid black; margin-right: 5px;"></div> <div style="text-align: center;">10.25</div> <div style="width: 20px; border-top: 1px solid black; margin-left: 5px;"></div> </div>		
<b>METHOD DEVELOPED:</b> Brainard - Kilman Hand Pump		<b>COMMENTS:</b> WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT DRAWING NOT TO SCALE		
<b>TIME DEVELOPED:</b> .5 hr <b>GALLONS DEVELOPED:</b> 16				

<b>MONITORING WELL INSTALLATION</b>		PROJECT: <b>Hulman ANG</b>	JOB NO. <b>005907-0003</b>	WELL NO. <b>MW5-02</b>
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 711984.5N 439876.9W		
BEGUN: 10/17/90	SUPERVISOR: T. Francy	WELL SITE: SITE 5	WATER LEVEL DATE: DEPTH/ELEV.	
FINISHED: 10/17/90	DRILLER: B. Repinski		10/24/90 : 5.1/579.54	

REFERENCE POINT & ELEVATION: NOTCHED TOP OF STAINLESS STEEL RISER, ELEV: 584.64		DEPTH (FT)	ELEV.(FT) MSL
		0.0	585.2

GENERALIZED GEOLOGIC LOG		DEPTH (FT)	ELEV.(FT) MSL
Depths	Description		
0	Asphalt and Fill	0.6	584.64
		1.0	584.2
	Dia: 10 inch Cover, 8 inch Skirt Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid Manufacturer: Clay and Balley, Kansas City, MO. GROUT: Cement: TYPE II Portland Cement Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite Water: 5 - 10 gallons	3.4	582.2
3.0	Clayey Silt, Dry, Grey		
4.0	Clay with Silt, Soft, Moist, Grey and Yellow Brown, Mottled,	5.4	579.7
	TOP OF SEAL ANNULAR SEAL Material Information: 1/2in. diameter bentonite pellets Manufacturer: Peltonite BOTTOM OF SEAL TOP OF SCREEN FILTER MATERIAL Quantity: 9 (50 lb.) Bags Material Information: 50 lb bags of uncrushed silica sand .85-.95 grade, subrounded-rounded Manufacturer: WAUPACA Materials, Waupaca, WI. SCREEN: Inner Dia: 2.0 inches Opening Width: .010 inches Material Information: Type 304 Stainless Steel Continuous Slot Well Screen Manufacturer: Diedrich Drilling, LaPorte, IN	7.6	577.6
10	Clayey-Silt, Very Soft, Wet, Brown to Yellow Brown, Mottled		
15	TILL: Clayey Silt with Sand and Gravel, Grey	17.8	567.4
16.5	Silty Sand, with Gravel and Cobbles	19.8	565.4
	BOTTOM OF SCREEN BOTTOM OF SUMP BOTTOM OF HOLE	20.0	565.2

**METHOD DRILLED:**  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

**METHOD DEVELOPED:**  
Brainard - Kilman Hand Pump

HOLE DIAMETER:  
10.25

TIME DEVELOPED: .5 hr

GALLONS DEVELOPED: 12

**COMMENTS:** WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE

<b>MONITORING WELL INSTALLATION</b>		PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. MW6-03
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 711900.6N 439624.1W		
BEGUN: 11:35 10/17/90	SUPERVISOR: T. Francy	WELL SITE: SITE 6	WATER LEVEL DATE: DEPTH/ELEV. 10/24/90 : 5.4/580.41	
FINISHED: 12:45 10/17/90	DRILLER: B. Repinski			
REFERENCE POINT & ELEVATION: NOTCHED TOP OF STAINLESS STEEL RISER, ELEV: 585.81			DEPTH (FT)	ELEV.(FT) MSL
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>TOP OF RISER CASING</p> <p>GROUT COLLAR</p> </div> <div style="text-align: center;"> <p>TOP OF FLUSH MOUNT SURFACE CASING</p> <p>LOCKED VENTILATED EXPANSION CAP</p> </div> <div style="text-align: center;"> <p>GROUND SURFACE</p> </div> </div>			0.0	586.4
<b>GENERALIZED GEOLOGIC LOG</b>			0.6	585.81
Depths	Description			
2	Top Soil: with Roots, Brown to Yellow-Brown	<p>FLUSH MOUNT STEEL PROTECTIVE CASING</p> <p>Dia: 10 inch Cover, 8 inch Skirt</p> <p>Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid</p> <p>Manufacturer: Clay and Bailey, Kansas City, MO.</p> <p>GROUT:</p> <p>Cement: TYPE II Portland Cement</p> <p>Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite</p> <p>Water: 5 - 10 gallons</p>	1.0	585.4
6	Clayey-Silt, Iron Nodules, Yellow Brown, with Black Mineral Stains	<p>RISER CASING:</p> <p>Inner Dia: 2.0 inches</p> <p>Material Information: Type 304 Stainless Steel</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p>TOP OF SEAL</p> <p>ANNULAR SEAL</p> <p>Material Information: 1/2in. diameter bentonite pellets</p> <p>Manufacturer: Peltonite</p>	3.2	583.2
10	As Above, Wet	<p>BOTTOM OF SEAL</p> <p>TOP OF SCREEN</p> <p>FILTER MATERIAL</p> <p>Quantity: 7 (50 lb.) Bags</p> <p>Material Information: 50 lb bags of uncrushed silica sand .85-.95 Grade, subrounded-rounded</p> <p>Manufacturer: Red Flint Filter Sands &amp; Gravel</p>	5.5	580.9
16	Clayey-Silt, Trace Sand, Soft Wet, Grey-Brown	<p>SCREEN:</p> <p>Inner Dia: 2.0 inches</p> <p>Opening Width: .010 inches</p> <p>Material Information: Type 304 Stainless Steel Continuous Slot Well Screen</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p>	7.6	578.8
20.2	TILL: Clayey-Sandy-Silt, Grey	<p>BOTTOM OF SCREEN</p> <p>BOTTOM OF SUMP</p> <p>BOTTOM OF HOLE</p>	17.8	568.6
20.2			19.8	566.6
20.2			20.2	566.2
METHOD DRILLED: 6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig  METHOD DEVELOPED: Brainard-Kilman Hand Pump			HOLE DIAMETER: <div style="display: flex; align-items: center;"> <div style="width: 20px; border-top: 1px solid black; margin-right: 5px;"></div> <div style="text-align: center; flex-grow: 1;">10.25</div> <div style="width: 20px; border-top: 1px solid black; margin-left: 5px;"></div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>TIME DEVELOPED: 30 Minutes</div> <div>GALLONS DEVELOPED: 14</div> <div>COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT DRAWING NOT TO SCALE</div> </div>	



MONITORING WELL INSTALLATION		PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. MW2-04
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 711449.8N 439981.7W		
BEGUN: 10/17/90	SUPERVISOR: T. Francy	WELL SITE: SITE 2	WATER LEVEL DATE: DEPTH/ELEV. 10/24/90 : 2.40/579.47	
FINISHED: 10/17/90	DRILLER: B. Repinski			

REFERENCE POINT & ELEVATION: NOTCHED TOP OF STAINLESS STEEL RISER, ELEV: 581.89		DEPTH (FT)	ELEV.(FT) MSL
<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>TOP OF RISER CASING</p> <p>GROUT COLLAR</p> </div> <div style="text-align: center;"> <p>TOP OF FLUSH MOUNT SURFACE CASING</p> <p>LOCKED VENTILATED EXPANSION CAP</p> </div> <div style="text-align: center;"> <p>GROUND SURFACE</p> </div> </div>		0.0	582.4

GENERALIZED GEOLOGIC LOG		DEPTH (FT)	ELEV.(FT) MSL
2	Very Silty-Clay, Dry, Grey	<p>TOP OF RISER CASING</p> <p>FLUSH MOUNT STEEL PROTECTIVE CASING</p> <p>Dia: 10 inch Cover, 8 inch Skirt</p> <p>Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid</p> <p>Manufacturer: Clay and Bailey, Kansas City, MO.</p> <p>GROUT:</p> <p>Cement: TYPE II Portland Cement</p> <p>Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite</p> <p>Water: 5 - 10 gallons</p> <p>RISER CASING:</p> <p>Inner Dia: 2.0 inches</p> <p>Material Information: Type 304 Stainless Steel</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p>	0.5 3.0 579.4
4	Silty-Clay, Moist, Yellow-Brown to Grey	<p>TOP OF SEAL</p> <p>ANNULAR SEAL</p> <p>Material Information: 1/2in. diameter bentonite pellets</p> <p>Manufacturer: Peltonite</p>	1.0 581.4
6	Clay and Silt, Moist, Wet Yellow Brown to Grey with Calcium Nodules	<p>BOTTOM OF SEAL</p> <p>TOP OF SCREEN</p> <p>FILTER MATERIAL</p> <p>Quantity: 5 1/3 (50 lb.) Bags</p> <p>Material Information: 50 lb bags of uncrushed silica sand .85-.95 grade, subrounded-rounded</p> <p>Manufacturer: WAUPACA Materials, Waupaca, WI.</p>	3.0 579.4
10	Clayey-Sandy-Silt, Moist-Wet with Calcium Nodules, Grey	<p>SCREEN:</p> <p>Inner Dia: 2.0 inches</p> <p>Opening Width: .010 inches</p> <p>Material Information: Type 304 Stainless Steel Continuous Slot Well Screen</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p>	5.2 577.2
16	TILL: Sand with Silty-Gravel, Wet	<p>BOTTOM OF SCREEN</p> <p>BOTTOM OF SUMP</p> <p>BOTTOM OF HOLE</p>	7.5 574.9
			17.8 564.7
			19.7 562.7
			20.1 562.3

METHOD DRILLED:  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

METHOD DEVELOPED:  
Brainard - Kilman Hand Pump

HOLE DIAMETER:  
10.25

TIME DEVELOPED: .5 hr

GALLONS DEVELOPED: 13-14

COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE

MONITORING WELL INSTALLATION			PROJECT: Hulman ANG		JOB NO. 005907-0003		WELL NO. MW4-05	
DRILLING CONTRACTOR: Exploration Technology, Inc.			COORDINATES: 711494.3N 440820.3W					
BEGUN: 10/17/90		SUPERVISOR: T. Francy		WELL SITE: SITE 4		WATER LEVEL DATE: DEPTH/ELEV.		
FINISHED: 10/18/90		DRILLER: B. Repinski				10/24/90 : 2.15/584.01		
REFERENCE POINT & ELEVATION: NOTCHED TOP OF STAINLESS STEEL RISER, ELEV: 586.16							DEPTH (FT)	ELEV.(FT) MSL
<p>Diagram labels: TOP OF RISER CASING, GROUT COLLAR, TOP OF FLUSH MOUNT SURFACE CASING, LOCKED VENTILATED EXPANSION CAP, GROUND SURFACE.</p>							0.0	586.7
GENERALIZED GEOLOGIC LOG							0.5	586.16
Depths	Description	<p>TOP OF RISER CASING</p> <p>FLUSH MOUNT STEEL PROTECTIVE CASING</p> <p>Dia: 10 inch Cover, 8 inch Skirt</p> <p>Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid</p> <p>Manufacturer: Clay and Balley, Kansas City, MO.</p> <p>GROUT:</p> <p>Cement: TYPE II Portland Cement</p> <p>Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite</p> <p>Water: 5 - 10 gallons</p> <p>RISER CASING:</p> <p>Inner Dia: 2.0 inches</p> <p>Material Information: Type 304 Stainless Steel</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p>TOP OF SEAL</p> <p>ANNULAR SEAL</p> <p>Material Information: 1/2in. diameter bentonite pellets</p> <p>Manufacturer: Peltonite</p> <p>BOTTOM OF SEAL</p> <p>TOP OF SCREEN</p> <p>FILTER MATERIAL</p> <p>Quantity: _____ (50 lb.) Bags</p> <p>Material Information: 50 lb bags of uncrushed silica sand .85-.95 grade, subrounded-rounded</p> <p>Manufacturer: WAUPACA Materials, Waupaca, WI.</p> <p>SCREEN:</p> <p>Inner Dia: 2.0 inches</p> <p>Opening Width: .010 inches</p> <p>Material Information: Type 304 Stainless Steel Continuous Slot Well Screen</p> <p>Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p>BOTTOM OF SCREEN</p> <p>BOTTOM OF SUMP</p> <p>BOTTOM OF HOLE</p>					1.0	585.7
5	Silt and Clay, Moist						3.0	583.7
							5.5	581.2
							7.5	579.2
10	Clayey Silt, Trace Very Fine Sand, Soft, Wet, Grey						17.7	569.0
16	TILL: Silty Sand with Clay, Gravel, Moist to Dry, Brown						19.8	566.9
							20.1	566.6
<p>METHOD DRILLED: 6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig</p> <p>METHOD DEVELOPED: Brainard - Kilman Hand Pump</p> <p>TIME DEVELOPED: 1 hr</p> <p>GALLONS DEVELOPED: 13-14</p>							<p>COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT</p> <p>DRAWING NOT TO SCALE</p>	



<b>MONITORING WELL INSTALLATION</b>		PROJECT: <b>Hulman ANG</b>	JOB NO. <b>005907-0003</b>	WELL NO. <b>P-01</b>
DRILLING CONTRACTOR: <b>Exploration Technology, Inc.</b>		COORDINATES: <b>712372.8N 439671.4W</b>		
BEGUN: <b>15:00 9/27/91</b>	SUPERVISOR: <b>T. Francy</b>	WELL SITE: <b>P-1</b>	WATER LEVEL DATE: DEPTH/ELEV. <b>9/30/90 : 3.90/581.42</b>	
FINISHED: <b>17:12 9/27/91</b>	DRILLER: <b>B. Repinski</b>			

REFERENCE POINT & ELEVATION: <b>NOTCHED TOP OF PVC RISER, ELEV: 585.32</b>		DEPTH (FT)	ELEV.(FT) MSL
		0.0	585.7
GENERALIZED GEOLOGIC LOG		0.4	585.32
Depths	Description		
	Top Soil: Silty Loam with Rootlets, Dry, Brown to Yellow-Brown		
2	Silty Clay to Very Clayey-Silt, Concretions, Moist Becomes Wet at 5 Feet, Black Mineral Stains Mottled Grey and Yellow-Brown	1.0	584.7
	<p>Labels: TOP OF RISER CASING, FLUSH MOUNT STEEL PROTECTIVE CASING, Dia: 10 inch Cover, 8 inch Skirt, Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid, Manufacturer: Clay and Bailey, Kansas City, MO.</p> <p>GROUT: Cement: TYPE II Portland Cement, Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite, Water: 5 - 10 gallons</p> <p>RISER CASING: Inner Dia: 1.5 inches, Material Information: Flush Jointed, Threaded Schedule 40 PVC, Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p>TOP OF SEAL, ANNULAR SEAL, Material Information: 1/2in. diameter bentonite pellets, Manufacturer: Peltonite</p> <p>BOTTOM OF SEAL, TOP OF SCREEN, FILTER MATERIAL, Quantity: <u>7</u> (50 lb.) Bags, Material Information: 50 lb bags of uncrushed silica sand #30, subrounded-rounded, Manufacturer: Red Flint Filter Sands &amp; Gravel</p> <p>SCREEN: Inner Dia: 1.5 inches, Opening Width: 10 Slot, Material Information: Schedule 40 PVC, Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p>BOTTOM OF SCREEN, BOTTOM OF SUMP, BOTTOM OF HOLE</p>	5.9	579.8
	As Above, Wet	8.0	577.7
10		9.9	575.8
16	TILL: Silt to Fine Sand with Pebbles, Trace-Organic Matter, Wet Becomes Dry at 20'	19.6	566.1
		19.9	565.8
		20.1	565.7

METHOD DRILLED:  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

METHOD DEVELOPED:  
Bailer

HOLE DIAMETER:  
10.25

TIME DEVELOPED: 45 Minutes

GALLONS DEVELOPED: 12

COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE



<b>MONITORING WELL INSTALLATION</b>		PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. P-02
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 712062.5N 440347.9W		
BEGUN: 08:58 9/30/90	SUPERVISOR: T. Francy	WELL SITE: P-2	WATER LEVEL DATE: DEPTH/ELEV. 10/9/90 : 5.3/581.45	
FINISHED: 10:50 9/30/90	DRILLER: B. Repinski			

REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 586.75		DEPTH (FT)	ELEV.(FT) MSL
<p>Labels in diagram: TOP OF RISER CASING, GROUT COLLAR, TOP OF FLUSH MOUNT SURFACE CASING, LOCKED VENTILATED EXPANSION CAP, GROUND SURFACE.</p>		0.0	587.1
GENERALIZED GEOLOGIC LOG		0.3	586.75
Depths	Description		
	Top Soil: Clayey Loam, Stiff, Brown to Yellow		
2	Silty Clay, Stiff, Plastic, Moist, Brown, Mottled		
	As Above, Trace-Fine-Sand	1.0	586.1
5		5.5	581.6
8	Sandy-Clay, Increasing Sand with Depth, Stiff Plastic, Moist, Brown	7.9	579.2
	Medium-Fine-Sand with pebbles and Trace-Clay, Moist	10.2	576.9
12	Silty -Clay, Brown, Moist		
14.5	TILL: Silt to Fine Sand with Pebbles, Hard, Dry	19.9	567.2
15.0		20.2	566.9
		20.2	566.9

**METHOD DRILLED:**  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

**METHOD DEVELOPED:**  
Bailer

**HOLE DIAMETER:**  
10.25

**TIME DEVELOPED:** 45 Minutes

**GALLONS DEVELOPED:** 12

**COMMENTS:** WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE



<b>MONITORING WELL INSTALLATION</b>		PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. P-03
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 711690.2N 439647.7N		
BEGUN: 10:15 9/27/90 FINISHED: 12:00 9/27/90	SUPERVISOR: T. Francy DRILLER: B. Repinski	WELL SITE: P-3	WATER LEVEL DATE: DEPTH/ELEV. 9/30/90 : 6.0/579.06	
REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 585.06				DEPTH (FT) ELEV.(FT) MSL
				0.0 585.7
GENERALIZED GEOLOGIC LOG				0.6 585.06
Depths	Description			
				1.0 584.7
15	Clay, Brown to Yellow, Graded to Silty Clay, with Some Sand			5.8 579.9
20	TILL: Fine Sand, Some Clay and Silt, Trace Gravel, Moist, becomes Dry			7.9 577.8
				9.9 575.8
				19.6 566.1
				19.9 565.8
				20.2 565.5
METHOD DRILLED: 6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig		HOLE DIAMETER: 10.25		
METHOD DEVELOPED: Bailer		TIME DEVELOPED: 45 Minutes GALLONS DEVELOPED: 12		COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT DRAWING NOT TO SCALE



<b>MONITORING WELL INSTALLATION</b>			PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. P-04
DRILLING CONTRACTOR: Exploration Technology, Inc.			COORDINATES: 711752.3N 441089.5W		
BEGUN: 13:15 9/26/90	SUPERVISOR: T. Francy	WELL SITE: P-4	WATER LEVEL DATE: DEPTH/ELEV. 9/30/90 : 6.95/576.38		
FINISHED: 09:15 9/27/90	DRILLER: B. Repinski				

REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 587.21		DEPTH (FT)	ELEV.(FT) MSL
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p style="margin: 5px 0;">TOP OF RISER CASING</p> <p style="margin: 5px 0;">GROUT COLLAR</p> </div> <div style="width: 45%;"> <p style="margin: 5px 0;">TOP OF FLUSH MOUNT SURFACE CASING</p> <p style="margin: 5px 0;">LOCKED VENTILATED EXPANSION CAP</p> <p style="margin: 5px 0;">GROUND SURFACE</p> </div> </div>		0.0	587.7
<p style="margin: 5px 0;">GENERALIZED GEOLOGIC LOG</p>		0.5	587.21
Depths	<div style="display: flex;"> <div style="width: 30%; border-right: 1px solid black; padding-right: 5px;"> <p style="margin: 5px 0;">Description</p> <p style="margin: 5px 0;">Clayey-Silt, Grey to Yellow Brown</p> </div> <div style="width: 70%; padding-left: 5px;"> <p style="margin: 5px 0;">TOP OF RISER CASING</p> <p style="margin: 5px 0;">FLUSH MOUNT STEEL PROTECTIVE CASING</p> <p style="margin: 5px 0;">Dia: 10 inch Cover, 8 inch Skirt</p> <p style="margin: 5px 0;">Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid</p> <p style="margin: 5px 0;">Manufacturer: Clay and Balley, Kansas City, MO.</p> <p style="margin: 5px 0;">GROUT:</p> <p style="margin: 5px 0;">Cement: TYPE II Portland Cement</p> <p style="margin: 5px 0;">Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite</p> <p style="margin: 5px 0;">Water: 5 - 10 gallons</p> <p style="margin: 5px 0;">RISER CASING:</p> <p style="margin: 5px 0;">Inner Dia: 1.5 inches</p> <p style="margin: 5px 0;">Material Information: Flush Jointed, Threaded Schedule 40 PVC</p> <p style="margin: 5px 0;">Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p style="margin: 5px 0;">TOP OF SEAL</p> <p style="margin: 5px 0;">ANNULAR SEAL</p> <p style="margin: 5px 0;">Material Information: 1/2in. diameter bentonite pellets</p> <p style="margin: 5px 0;">Manufacturer: Peltonite</p> <p style="margin: 5px 0;">BOTTOM OF SEAL</p> <p style="margin: 5px 0;">TOP OF SCREEN</p> <p style="margin: 5px 0;">FILTER MATERIAL</p> <p style="margin: 5px 0;">Quantity: 6.333 (50 lb.) Bags</p> <p style="margin: 5px 0;">Material Information: 50 lb bags of uncrushed silica sand #30, subrounded-rounded</p> <p style="margin: 5px 0;">Manufacturer: Red Flint Filter Sands &amp; Gravel</p> <p style="margin: 5px 0;">SCREEN:</p> <p style="margin: 5px 0;">Inner Dia: 1.5 inches</p> <p style="margin: 5px 0;">Opening Width: .010 inches</p> <p style="margin: 5px 0;">Material Information: Schedule 40PVC</p> <p style="margin: 5px 0;">Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p style="margin: 5px 0;">BOTTOM OF SCREEN</p> <p style="margin: 5px 0;">BOTTOM OF SUMP</p> <p style="margin: 5px 0;">BOTTOM OF HOLE</p> </div> </div>	1.0	586.7
2	<p style="margin: 5px 0;">Silty-Clay, Increasing Silt with depth, Moist, Grey to Yellow Brown</p>		
5	<p style="margin: 5px 0;">As Above, Wet</p>	5.75	581.9
	<p style="margin: 5px 0;">TILL, Clay with sand, silt and gravel, Very Dense, Wet</p>	8.0	579.7
16	<p style="margin: 5px 0;">As Above, Dry</p>	9.9	577.8
18	<p style="margin: 5px 0;">As Above, Dry</p>	19.6	568.1
	<p style="margin: 5px 0;">As Above, Dry</p>	19.9	567.8
	<p style="margin: 5px 0;">As Above, Dry</p>	20.0	567.7

METHOD DRILLED:  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

METHOD DEVELOPED:  
Bailer

HOLE DIAMETER:  
10.25

TIME DEVELOPED: 45 Minutes

GALLONS DEVELOPED: 11.5

COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT

DRAWING NOT TO SCALE

<b>MONITORING WELL INSTALLATION</b>		PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. P-05
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 711433.8N 440208.4W		
BEGUN: 12:50 9/29/90	SUPERVISOR: T. Francy	WELL SITE: P-5	WATER LEVEL DATE: DEPTH/ELEV.	
FINISHED: 14:35 9/29/90	DRILLER: B. Repinski		10/9/90 : 1.45/581.64	

REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 583.09		DEPTH (FT)	ELEV.(FT) MSL
		0.0	583.5
GENERALIZED GEOLOGIC LOG		0.4	583.09
Depths	Description		
2	Top Soil, Silty-Clayey-Loam, Damp		
	Silty-Clay, Stiff, Dry, Brown		
	<p> <b>FLUSH MOUNT STEEL PROTECTIVE CASING</b>            Dia: 10 inch Cover, 8 inch Skirt            Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid            Manufacturer: Clay and Balley, Kansas City, MO.  <b>GROUT:</b>            Cement: TYPE II Portland Cement            Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite            Water: 5 - 10 gallons  <b>RISER CASING:</b>            Inner Dia: 1.5 inches            Material Information: Flush Jointed, Threaded Schedule 40 PVC            Manufacturer: Diedrich Drilling, LaPorte, IN  <b>TOP OF SEAL</b>  <b>ANNULAR SEAL</b>            Material Information: 1/2in. diameter bentonite pellets            Manufacturer: Peltonite  <b>BOTTOM OF SEAL</b>  <b>TOP OF SCREEN</b>  <b>FILTER MATERIAL</b>            Quantity: 6.8 (50 lb.) Bags            Material Information: 50 lb bags of uncrushed silica sand #30, subrounded-rounded            Manufacturer: Red Flint Filter Sands &amp; Gravel  <b>SCREEN:</b>            Inner Dia: 1.5 inches            Opening Width: .010 inches            Material Information: Schedule 40PVC            Manufacturer: Diedrich Drilling, LaPorte, IN  <b>BOTTOM OF SCREEN</b>  <b>BOTTOM OF SUMP</b>  <b>BOTTOM OF HOLE</b> </p>	1.0	582.5
9	Silty-Clay, Trace Fine to Medium-Sand, Increasing Sand with Depth, Stiff, Moist, Grey	5.3	578.2
15	Till: Sandy-Clay, with Small Pebbles, Firm, Wet	7.9	575.6
18	As Above, Dry	10.1	573.4
		19.8	563.7
		20.1	563.4
		20.1	563.4

**METHOD DRILLED:**  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

**METHOD DEVELOPED:**  
Bailer

**HOLE DIAMETER:**  
10.25

**TIME DEVELOPED:** 45 Minutes

**GALLONS DEVELOPED:** 12

**COMMENTS:** WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE

<b>MONITORING WELL INSTALLATION</b>		PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. P-06
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 711086.8N 440856.2W		
BEGUN: 08:30 9/28/90	SUPERVISOR: T. Francy	WELL SITE: P-6	WATER LEVEL DATE: DEPTH/ELEV. 9/30/90 : 3.30/584.8	
FINISHED: 11:15 9/28/90	DRILLER: B. Repinski			

REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 588.10		DEPTH (FT)	ELEV.(FT) MSL
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>TOP OF RISER CASING</p> <p>GROUT COLLAR</p> </div> <div style="width: 40%;"> <p>TOP OF FLUSH MOUNT SURFACE CASING</p> <p>LOCKED VENTILATED EXPANSION CAP</p> <p>GROUND SURFACE</p> </div> </div>		0.0	588.5
<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>GENERALIZED GEOLOGIC LOG</p> </div> <div style="width: 40%;"> <p>TOP OF RISER CASING</p> <p>FLUSH MOUNT STEEL PROTECTIVE CASING Dia: 10 inch Cover, 8 inch Skirt Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid Manufacturer: Clay and Bailey, Kansas City, MO.</p> <p>GROUT: Cement: TYPE II Portland Cement Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite Water: 5 - 10 gallons</p> <p>RISER CASING: Inner Dia: 1.5 inches Material Information: Flush Jointed, Threaded Schedule 40 PVC Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p>TOP OF SEAL ANNULAR SEAL Material Information: 1/2in. diameter bentonite pellets Manufacturer: Peltonite</p> <p>BOTTOM OF SEAL TOP OF SCREEN FILTER MATERIAL Quantity: 7 (50 lb.) Bags Material Information: 50 lb bags of uncrushed silica sand #30, subrounded-rounded Manufacturer: Red Flint Filter Sands &amp; Gravel</p> <p>SCREEN: Inner Dia: 1.5 inches Opening Width: .010 inches Material Information: Schedule 40PVC Manufacturer: Diedrich Drilling, LaPorte, IN</p> <p>BOTTOM OF SCREEN</p> <p>BOTTOM OF SUMP</p> <p>BOTTOM OF HOLE</p> </div> </div>		0.4	588.10
2	<p>Top Soil, Slightly Moist, Brown-Grey, Mottled</p>	1.0	587.5
6	<p>Silty-Clay, Concretions, Black Mineral Stains, Moist, Grey to Yellow Brown, Mottled, Moist</p>	5.7	582.2
10	<p>Clayey-Silt, Soft, Becomes Wet</p>	7.9	580.6
16	<p>As Above, Becomes Very-Clayey, Wet, Grey to Yellow Brown</p>	9.9	578.7
	<p>Till: Silt and Clay, with Sand and Trace-Gravel, Dense, 45° Fracture, Dry at 16.5', Grey</p>	19.5	569.5
		19.8	569.2
		19.8	569.2

METHOD DRILLED:  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

METHOD DEVELOPED:  
Bailer

HOLE DIAMETER:  
10.25

TIME DEVELOPED: 40 Minutes

GALLONS DEVELOPED: 9

COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE

<b>MONITORING WELL INSTALLATION</b>			PROJECT: Hulman ANG	JOB NO. 005907-0003	WELL NO. P-07
DRILLING CONTRACTOR: Exploration Technology, Inc.			COORDINATES: 710931.0N 440049.0W		
BEGUN: 08:20 9/29/90	SUPERVISOR: T. Francy	WELL SITE: P-7	WATER LEVEL DATE: DEPTH/ELEV. 10/1/90 : 2.95/579.07		
FINISHED: 10:30 9/29/90	DRILLER: B. Repinski				

REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 582.02		DEPTH (FT)	ELEV.(FT) MSL																					
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>TOP OF RISER CASING</p> <p>GROUT COLLAR</p> </div> <div style="width: 45%;"> <p>TOP OF FLUSH MOUNT SURFACE CASING</p> <p>LOCKED VENTILATED EXPANSION CAP</p> <p>GROUND SURFACE</p> </div> </div>		0.0	582.4																					
<b>GENERALIZED GEOLOGIC LOG</b>		0.4	582.02																					
Depths	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">Description</th> <th style="width: 35%;"></th> <th style="width: 60%;"></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">2</td> <td style="vertical-align: top;"> <p>Silty-Clay, with Black Mineral Stains, Moist, Brown</p> </td> <td style="vertical-align: top;"> <p>TOP OF RISER CASING</p> <p>FLUSH MOUNT STEEL PROTECTIVE CASING Dia: 10 inch Cover, 8 inch Skirt Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid Manufacturer: Clay and Bailey, Kansas City, MO.</p> <p>GROUT: Cement: TYPE II Portland Cement Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite Water: 5 - 10 gallons</p> </td> </tr> <tr> <td style="text-align: center;">5</td> <td style="vertical-align: top;"> <p>As Above, with Trace Fine-Sand</p> </td> <td style="vertical-align: top;"> <p>RISER CASING: Inner Dia: 1.5 inches Material Information: Flush Jointed, Threaded Schedule 40 PVC Manufacturer: Diedrich Drilling, LaPorte, IN</p> </td> </tr> <tr> <td style="text-align: center;">7</td> <td style="vertical-align: top;"> <p>Silty-Clay, Weathered Horizon at 7.5', Small Rocks Present, Some Black Mineral Stains</p> </td> <td style="vertical-align: top;"> <p>TOP OF SEAL</p> <p>ANNULAR SEAL Material Information: 1/2in. diameter bentonite pellets Manufacturer: Peltonite</p> </td> </tr> <tr> <td style="text-align: center;">10</td> <td style="vertical-align: top;"> <p>Sandy-Clay, Wet at 11.5 Feet, Grey</p> </td> <td style="vertical-align: top;"> <p>BOTTOM OF SEAL</p> <p>TOP OF SCREEN</p> <p>FILTER MATERIAL Quantity: 6.9 (50 lb.) Bags Material Information: 50 lb bags of uncrushed silica sand #30, subrounded-rounded Manufacturer: Red Flint Filter Sands &amp; Gravel</p> </td> </tr> <tr> <td style="text-align: center;">15</td> <td style="vertical-align: top;"> <p>TILL: Interbedded Sand and Sandy Clays, Discontinuous, Trace-Pebbles, Wet</p> </td> <td style="vertical-align: top;"> <p>SCREEN: Inner Dia: 1.5 inches Opening Width: .010 inches Material Information: Schedule 40PVC Manufacturer: Diedrich Drilling, LaPorte, IN</p> </td> </tr> <tr> <td style="text-align: center;">18</td> <td style="vertical-align: top;"> <p>As Above, No Pebbles Becomes Dry at 18.5'</p> </td> <td style="vertical-align: top;"> <p>BOTTOM OF SCREEN</p> <p>BOTTOM OF SUMP</p> <p>BOTTOM OF HOLE</p> </td> </tr> </tbody> </table>	Description			2	<p>Silty-Clay, with Black Mineral Stains, Moist, Brown</p>	<p>TOP OF RISER CASING</p> <p>FLUSH MOUNT STEEL PROTECTIVE CASING Dia: 10 inch Cover, 8 inch Skirt Material Information: 3 Foot Long Galvanized Steel Skirt with Cast Iron Lid Manufacturer: Clay and Bailey, Kansas City, MO.</p> <p>GROUT: Cement: TYPE II Portland Cement Bentonite: Quik Gel High Yield Bentonite, fact mixing high viscosity bentonite Water: 5 - 10 gallons</p>	5	<p>As Above, with Trace Fine-Sand</p>	<p>RISER CASING: Inner Dia: 1.5 inches Material Information: Flush Jointed, Threaded Schedule 40 PVC Manufacturer: Diedrich Drilling, LaPorte, IN</p>	7	<p>Silty-Clay, Weathered Horizon at 7.5', Small Rocks Present, Some Black Mineral Stains</p>	<p>TOP OF SEAL</p> <p>ANNULAR SEAL Material Information: 1/2in. diameter bentonite pellets Manufacturer: Peltonite</p>	10	<p>Sandy-Clay, Wet at 11.5 Feet, Grey</p>	<p>BOTTOM OF SEAL</p> <p>TOP OF SCREEN</p> <p>FILTER MATERIAL Quantity: 6.9 (50 lb.) Bags Material Information: 50 lb bags of uncrushed silica sand #30, subrounded-rounded Manufacturer: Red Flint Filter Sands &amp; Gravel</p>	15	<p>TILL: Interbedded Sand and Sandy Clays, Discontinuous, Trace-Pebbles, Wet</p>	<p>SCREEN: Inner Dia: 1.5 inches Opening Width: .010 inches Material Information: Schedule 40PVC Manufacturer: Diedrich Drilling, LaPorte, IN</p>	18	<p>As Above, No Pebbles Becomes Dry at 18.5'</p>	<p>BOTTOM OF SCREEN</p> <p>BOTTOM OF SUMP</p> <p>BOTTOM OF HOLE</p>	1.0	581.4
Description																								
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		5.4	577.0																					
		7.9	574.5																					
		10.0	572.4																					
		19.7	562.7																					
		20.0	562.4																					
		20.05	562.35																					

**METHOD DRILLED:**  
6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig

**METHOD DEVELOPED:**  
Bailer

**HOLE DIAMETER:**  
10.25

**COMMENTS:** WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE

TIME DEVELOPED: 45 Minutes

GALLONS DEVELOPED: 10.5

<b>MONITORING WELL INSTALLATION</b>		PROJECT: Hulman ANG		JOB NO. 005907-0003	WELL NO. P-08
DRILLING CONTRACTOR: Exploration Technology, Inc.		COORDINATES: 710669.6N 440394.0W			
BEGUN: 13:40 9/28/90	SUPERVISOR: T. Aebie	WELL SITE: P-8		WATER LEVEL DATE: DEPTH/ELEV.	
FINISHED: 16:35 9/28/90	DRILLER: B. Repinski			10/1/90 : 4.20/580.5	

REFERENCE POINT & ELEVATION: NOTCHED TOP OF PVC RISER, ELEV: 584.70				DEPTH (FT)	ELEV.(FT) MSL										
				0.0	585.0										
				0.3	584.70										
<b>GENERALIZED GEOLOGIC LOG</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Depths</th> <th style="width: 80%;">Description</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>Silty-Clay, with Black Mineral Stains, Moist, Brown</td> </tr> <tr> <td>5</td> <td>As Above, Becomes Grey at 5.5' Mottled, Moist</td> </tr> <tr> <td>9</td> <td>Clayey-Medium Sand Silt, Moist, Wet at 11', Grey with Brown Mottling</td> </tr> <tr> <td>16</td> <td>TILL: Silty-Sand, Trace Cobbles, Becomes Dry, Grey</td> </tr> </tbody> </table>				Depths	Description	2	Silty-Clay, with Black Mineral Stains, Moist, Brown	5	As Above, Becomes Grey at 5.5' Mottled, Moist	9	Clayey-Medium Sand Silt, Moist, Wet at 11', Grey with Brown Mottling	16	TILL: Silty-Sand, Trace Cobbles, Becomes Dry, Grey	1.0	584.0
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				7.7	577.3										
METHOD DRILLED: 6.25 inch inner diameter hollow stem augers spun into the ground with a CME-55 drilling rig METHOD DEVELOPED: Bailer HOLE DIAMETER: 10.25 TIME DEVELOPED: 35 Minutes GALLONS DEVELOPED: 11.5				10.2	574.8										
				20.0	565.0										
				20.3	564.7										
				20.3	564.7										

COMMENTS: WATER LEVEL RECORDED ON DATE OF WELL DEVELOPMENT  
DRAWING NOT TO SCALE

**APPENDIX C**  
**Survey Data and Slug Test Calculations**

**SURVEY DATA**



BH1-14	710871.5 N	440331.5 W	584.80
BH1-15	710839.8 N	440285.6 W	584.40
BH2-06	711621.8 N	439977.8 W	583.60
BH2-07	711632.8 N	440126.5 W	585.60
BH2-08	711628.3 N	440178.9 W	584.60
BH2-09	711514.2 N	440019.0 W	583.40
BH4-10	711613.9 N	440858.5 W	587.19
BH4-11	711544.1 N	440869.7 W	587.20
BH4-12	711554.7 N	440966.1 W	587.60
BH4-13	711573.5 N	441021.1 W	587.94
BH5-02	712182.0 N	439920.4 W	585.39
BH5-03	712111.9 N	439936.5 W	585.80
BH6-04	712093.3 N	439755.4 W	585.90
BH6-05	712041.9 N	439763.4 W	586.37
MW1-06	710798.2 N	440184.5 W	583.33
MW2-04	711449.8 N	439981.7 W	581.89
MW4-05	711494.3 N	440820.3 W	586.16
MW5-02	711984.5 N	439876.9 W	584.64
MW6-03	711900.6 N	439624.1 W	585.81
MWB-01, BHB-01	712588.6 N	440367.2 W	588.05
PIEZO-01	712372.8 N	439671.4 W	585.32
PIEZO-02	712062.5 N	440347.9 W	586.75
PIEZO-03	711690.2 N	439647.7 W	585.06
PIEZO-04	711752.3 N	441089.5 W	587.21
PIEZO-05	711433.8 N	440208.4 W	583.09
PIEZO-06	711086.8 N	440856.2 W	588.10
PIEZO-07	710931.0 N	440049.0 W	582.02
PIEZO-08	710669.6 N	440394.0 W	584.70
NE COR #37	711204.9 N	439970.1 W	
SE COR #33	711732.8 N	440298.0 W	

REFERENCE LINE

## SLUG TEST CALCULATIONS

Using method: Bouwer & Rice Water Res., Vol. 12, No. 3, June 1976

a) From semi-log plot ( $\log Y_t$  vs  $t$ )

$$Y_o = 2.17 \text{ ft.}; \quad \text{at } t = 12 \text{ sec.}, Y_t = 1.80 \text{ ft.}$$

$$\text{so } \left(\frac{1}{t}\right) \ln \frac{Y_o}{Y_t} = \frac{1}{12} \text{ sec.} \quad \ln \frac{2.17}{1.80} = 1.56 \times 10^{-3} \text{ sec}^{-1}$$

$$\text{b) } \frac{L_e}{r_w} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}} = 122.4$$

$$\text{c) From Figure 3, using } \frac{L_e}{r_w} = 122.4, C=4.8$$

d) For fully penetrating well, assume  $D = H$  and use equation (9)

$$\begin{aligned} \ln \frac{R_e}{r_w} &= \left( \frac{1.1}{\ln 17.4 \text{ ft.}/.0833 \text{ ft.}} + \frac{4.8}{10.2 \text{ ft.}/0.0833 \text{ ft.}} \right)^{-1} \\ &= (.0259 + .0392)^{-1} = (.02451)^{-1} \end{aligned}$$

$$\ln \frac{R_e}{r_w} = 4.080$$

$$\text{e) Using equation (5), } K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \left(\frac{1}{t}\right) \left(\frac{Y_o}{Y_t}\right)$$

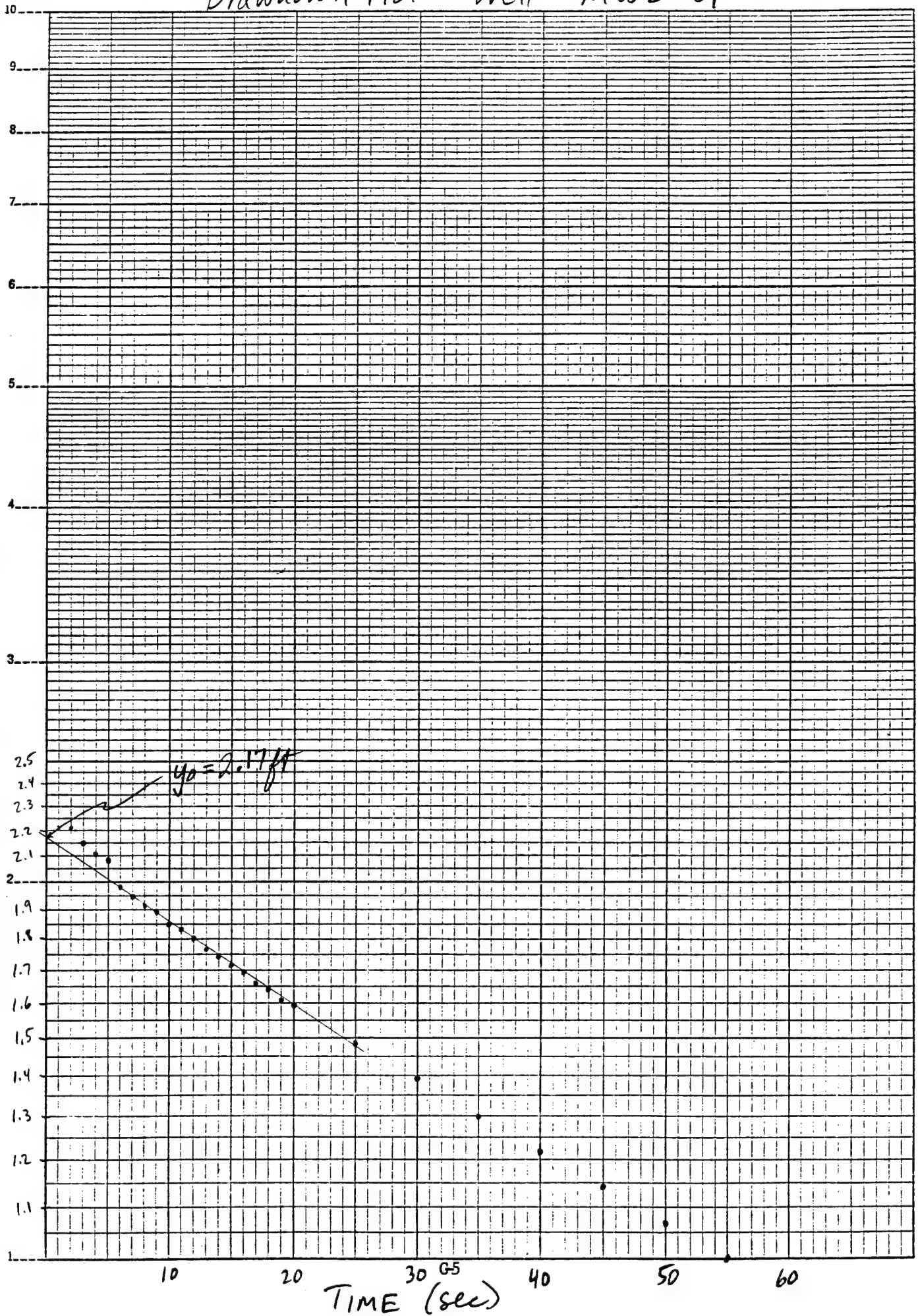
$$K = \frac{(.0833 \text{ ft})^2 (4.080)}{2 (10.2)} (1.58 \times 10^{-3} \text{ sec}^{-1})$$

$$K = 2.16 \times 10^{-5} \text{ ft./sec.} = 6.6 \times 10^{-4} \text{ cm/sec.}$$

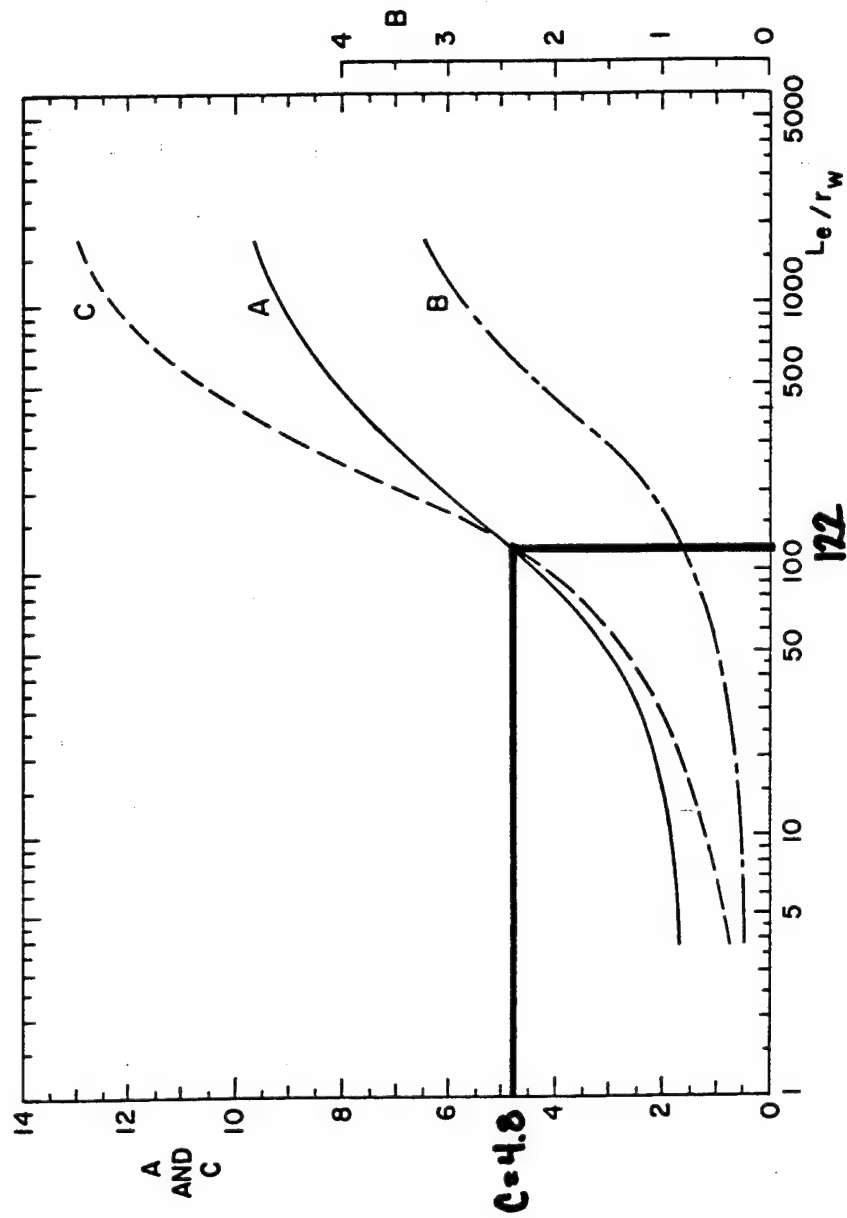
# Drawdown Plot - Well MWB-01

Drawdown, ft (ft)

1 IN = 1 CYCLE X 70 DIVISIONS  
KEUFFEL & ESSER CO.  
MADE IN U.S.A.

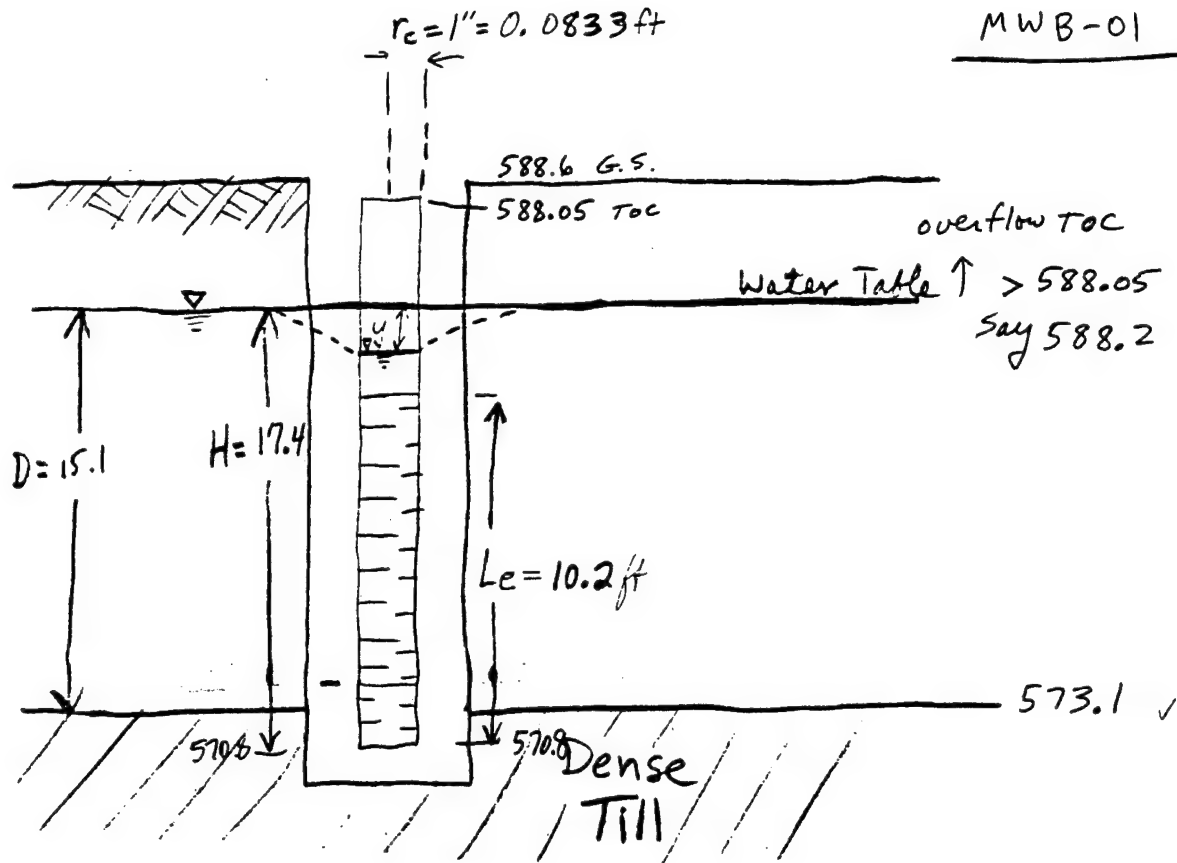


# GROUNDWATER HYDROLOGY



Curves relating coefficients A, B, and C to  $L_e/r_w$ .

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METCALF & EDDY, ENGINEERS

Using method: Bouwer & Rice, 1976

a) From semi-log plot ( $\log Y_t$  vs  $t$ )

$$Y_o = 1.77 \text{ ft.}; \quad t = 14 \text{ sec.}, \quad Y_t = 1.73 \text{ ft.}$$

$$\text{so} \quad \left(\frac{1}{t}\right) \ln \frac{Y_o}{Y_t} = \frac{1}{14} \text{ sec.} \quad \frac{1.77}{1.73} = 1.63 \times 10^{-3} \text{ sec.}^{-1}$$

$$\text{b)} \quad \frac{L_e}{r_w} = \frac{10.2}{.0833} = 122.4$$

$$\text{c)} \quad \text{From Figure 3, using } \frac{L}{r_w} = 122.4, \quad C = 4.8$$

d) For fully penetrating well, assume  $D = H$  and use equation (9)

$$\ln \frac{R_e}{r_w} = \left( \frac{1.1}{\ln (15/.0883)} + \frac{4.8}{10.2/.0833} \right)^{-1}$$

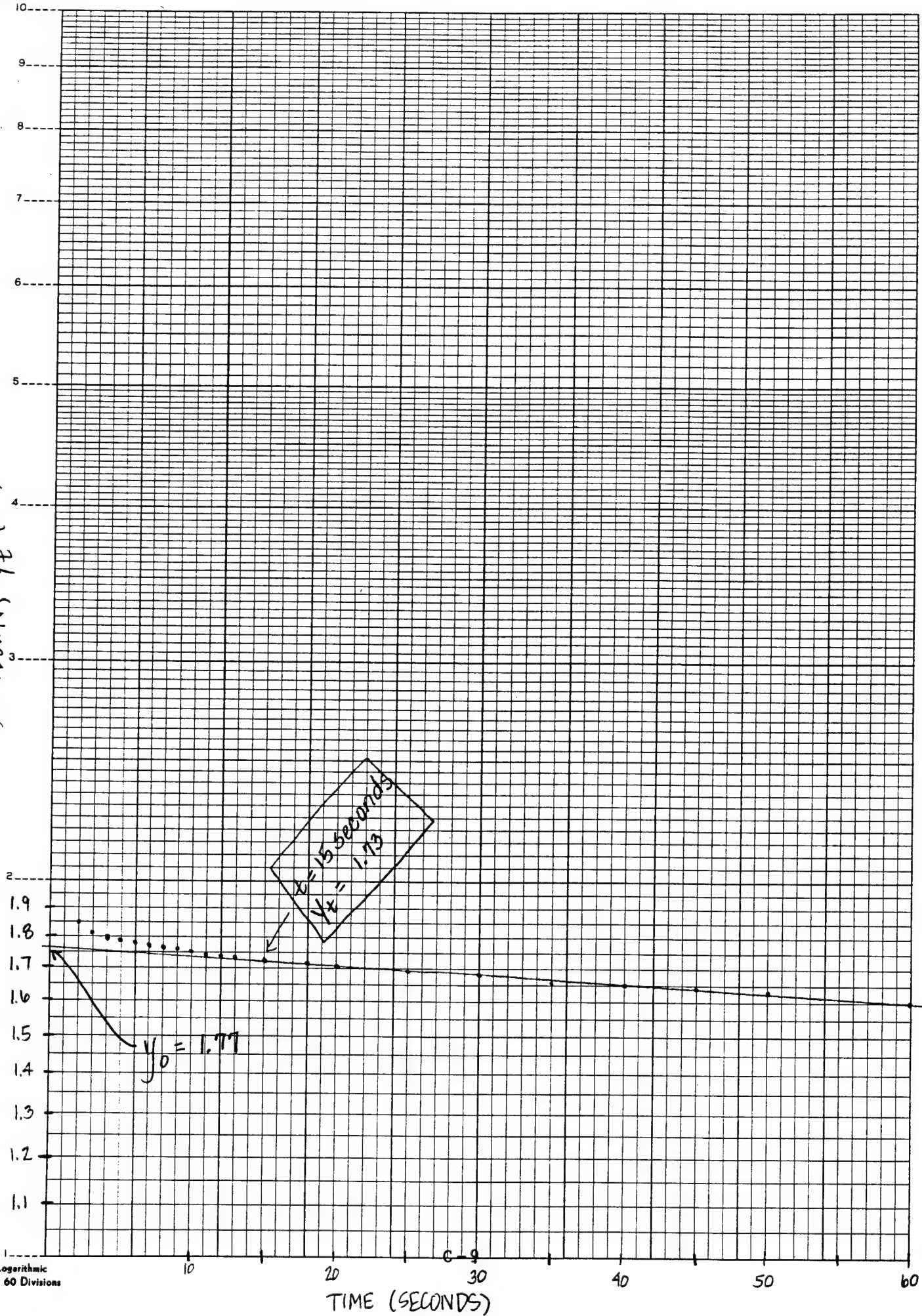
$$\ln \frac{R_e}{r_w} = 3.98$$

$$\text{e)} \quad \text{Using equation (5), } K = \frac{r_c^2 \ln R_e / r_w}{2L} \left(\frac{1}{t}\right) \left(\ln \frac{Y_o}{Y_t}\right)$$

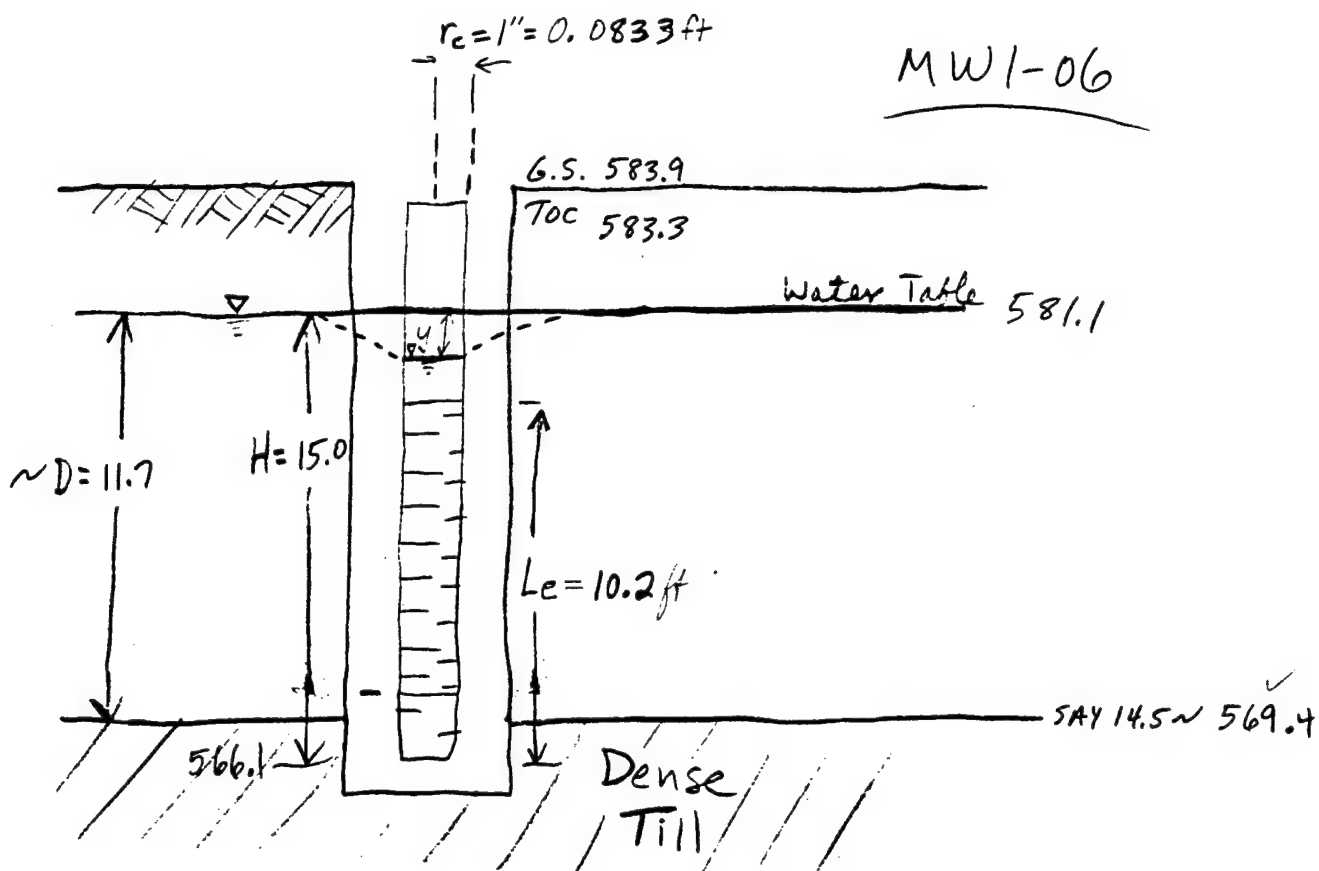
$$K = \frac{(.0833 \text{ ft.})^2 (3.98)}{2 (10.2 \text{ ft.})} (1.63 \times 10^{-3} \text{ sec.}^{-1})$$

$$K = 2.21 \times 10^{-6} \text{ ft./sec.} = 6.73 \times 10^{-5} \text{ cm/sec.}$$

DRAWDOWN,  $y_t$  (Ft)







Using method: Bouwer & Rice, 1976

a) From semi-log plot ( $\log Y_t$  vs  $t$ )

$$Y_o = 1.91 \text{ ft.}; \quad t = 20 \text{ sec.}, \quad Y_t = 1.83 \text{ ft.}$$

$$\text{so} \quad \left(-\frac{1}{t}\right) \ln \frac{Y_o}{Y_t} = \frac{1}{20} \text{ sec.} \left(\ln \frac{1.91}{1.83}\right) = .00214 \text{ sec.}^{-1} = 2.14 \times 10^{-3} \text{ sec.}^{-1}$$

$$\text{b)} \quad \frac{L_e}{r_w} = \frac{10.2}{.0833} = 122.4$$

$$\text{c)} \quad \text{From Figure 3, using } \frac{L_e}{r_w} = 122.4, \quad C = 4.8$$

d) For fully penetrating well, assume  $D = H$  and use equation (9)

$$\ln \frac{R_e}{r_w} = \left( \frac{1.1}{\ln (15.3/.0833)} + \frac{4.8}{10.2/.0833} \right)^{-1} = .2502^{-1}$$

$$\ln \frac{R_e}{r_w} = 4.00$$

$$\text{e)} \quad \text{Using equation (5), } K = \frac{r_c^2 \ln R_e / r_w}{2L} \left(-\frac{1}{t}\right) \left(\ln \frac{Y_o}{Y_t}\right)$$

$$K = \frac{(.0833 \text{ ft.})^2 (4.00)}{2(10.2 \text{ ft.})} (2.14 \times 10^{-3} \text{ sec.}^{-1})$$

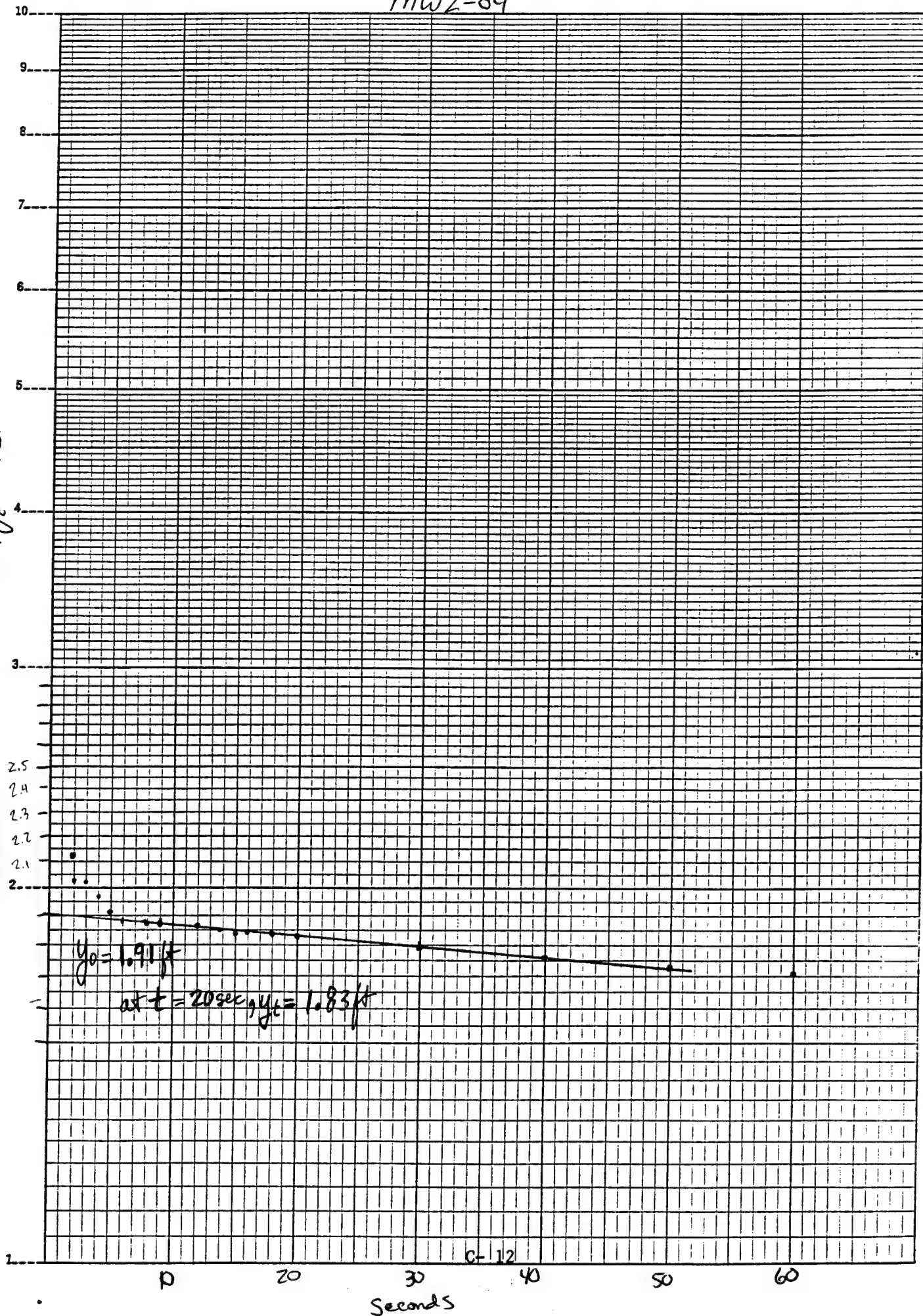
$$= 2.91 \times 10^{-6} \text{ ft./sec.}$$

$$= 8.9 \times 10^{-5} \text{ cm/sec.}$$

MW2-04

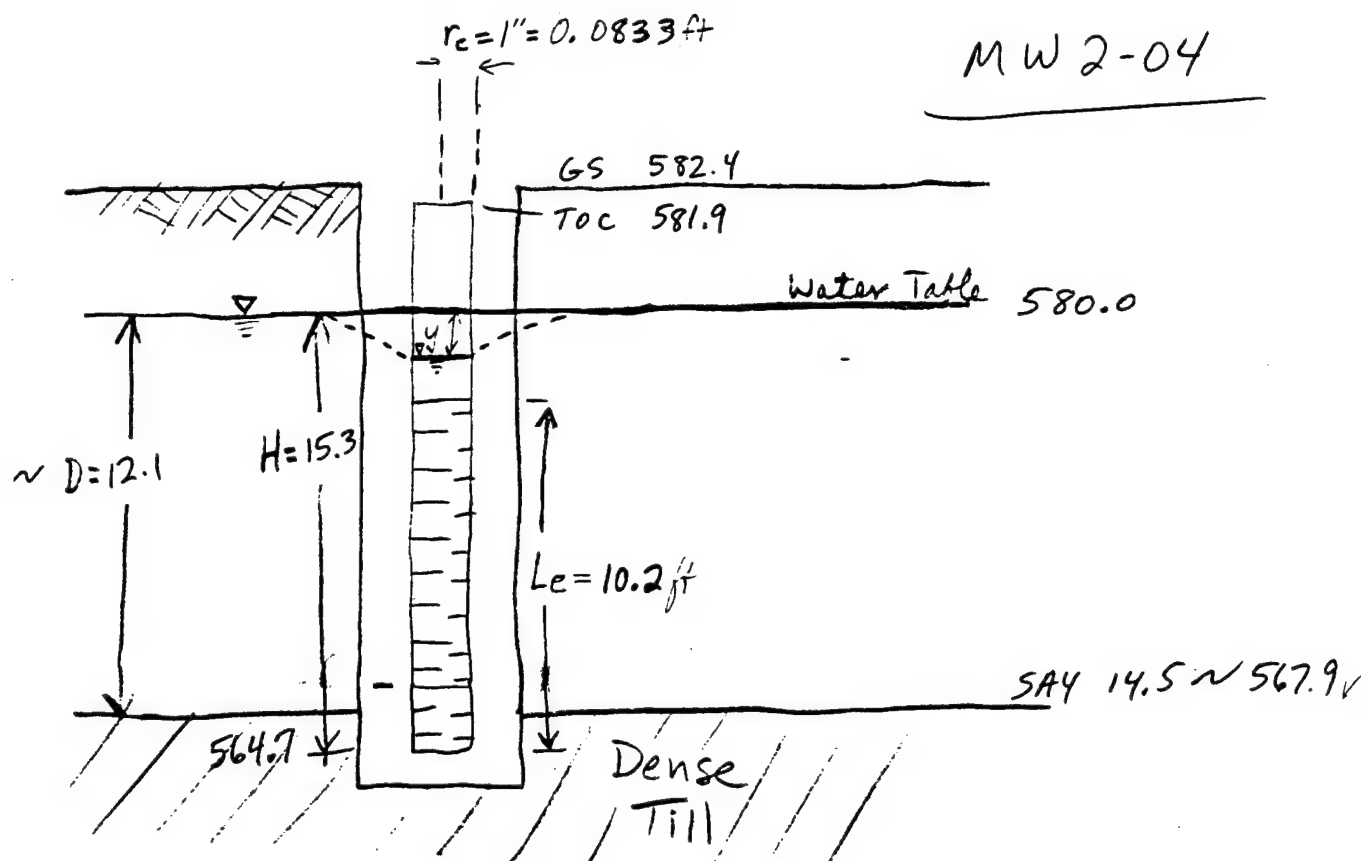
Draw Down  $y_t$  in feet

KE SEMI-LOGARITHMIC 46 4650  
1 CYCLE X 70 DIVISIONS  
MADE IN U.S.A.  
KEUFFEL & ESSER CO.



C-12

Project Hozwrap-Hulman IANG Acct. No. 5907-8 Page      of       
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METCALF & EDDY, ENGINEERS

Using method: Bouwer & Rice, 1976

a) From semi-log plot ( $\log Y_t$  vs  $t$ )

$$Y_o = 1.82 \text{ ft.}; \quad \text{at } t = 12 \text{ sec.}, Y_t = 1.69 \text{ ft.}$$

$$\text{so } \left(\frac{1}{t}\right) \ln \frac{Y_o}{Y_t} = \frac{1}{25} \ln \frac{1.77}{1.58} = 4.54 \times 10^{-3} \text{ sec.}^{-1}$$

$$\text{b) } \frac{L_e}{r_w} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}} = 122.4$$

$$\text{c) } \text{From Figure 3, using } \frac{L_e}{r_w} = 122.4, \quad C = 48$$

d) For fully penetrating well, assume  $D = H$  and use equation (9)

$$\ln \frac{R_e}{R_w} = \left( \frac{1.1}{\ln (16.2/.0833)} + \frac{4.8}{10.2/.0833} \right)^{-1}$$

$$\ln \frac{R_e}{r_w} = 4.033$$

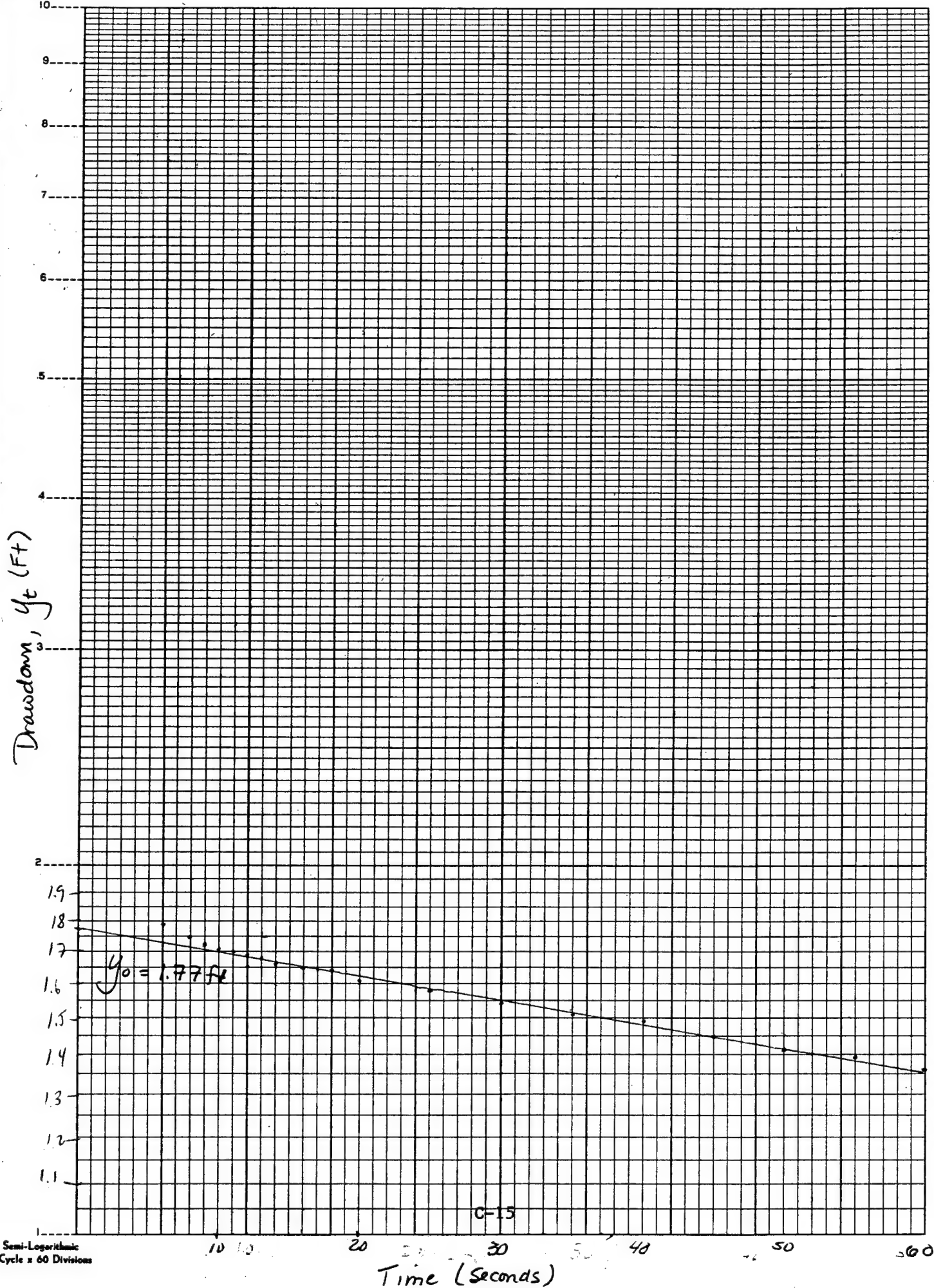
$$\text{e) } \text{Using equation (5), } K = \frac{r_c^2 \ln (R_e/r_w)}{2L} \left(\frac{1}{t}\right) \left(\ln \frac{Y_o}{Y_t}\right)$$

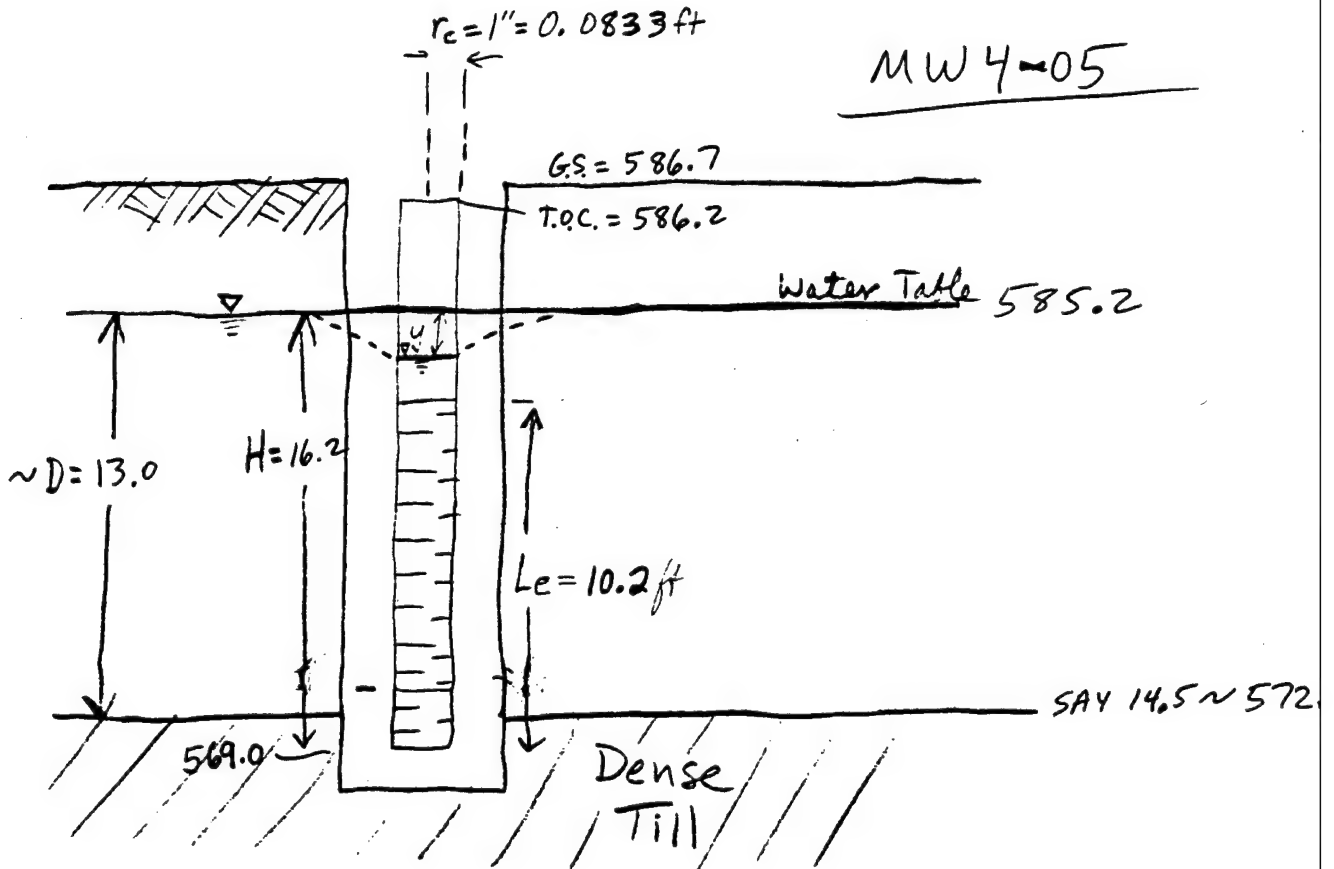
$$K = \frac{(.0833 \text{ ft.})^2 (4.033)}{2(10.2)} (4.54 \times 10^{-3} \text{ sec.}^{-1})$$

$$K = 6.23 \times 10^{-6} \text{ ft./sec.}$$

$$K = 1.90 \times 10^{-4} \text{ cm/sec.}$$

# Drawdown Plot MW 4-05





NONREPRODUCIBLE GRID FORM 145

METCALF & EDDY, ENGINEERS

Using method: Bouwer & Rice, 1976

a) From semi-log plot ( $\log Y_t$  vs  $t$ ),

$$Y_0 = 1.81 \text{ ft. at } t = 37.5 \text{ sec.}, Y_t = 1.75 \text{ ft.}$$

$$\text{so } \left(\frac{1}{t}\right) \left(\ln \frac{Y_0}{Y_t}\right) = \frac{1}{37.5} \ln \frac{1.81}{1.75} = 0.0008990 \text{ sec.}^{-1} = 8.99 \times 10^{-4} \text{ sec.}$$

$$\text{b) } \frac{L_e}{r_w} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}} = 122.4$$

$$\text{c) From Figure 3, using } \frac{L_e}{r_w} = 122.4, C = 4.8$$

d) For fully penetrating well, assume  $D = H$  and use equation (9)

$$\ln \frac{R_e}{r_w} = \left( \frac{1.1}{\ln (12.5 \text{ ft.} / .0833 \text{ ft.})} + \frac{4.8}{10.2 \text{ ft.} / .0833 \text{ ft.}} \right)^{-1}$$

$$\ln \frac{R_e}{r_w} = (.2195 + .0392)^{-1} = (.02587)^{-1} = 3.865$$

$$\text{e) Using equation (5), } K = \frac{r_c^2 \ln (R_e / r_w)}{2L} \left(\frac{1}{t}\right) \left(\ln \frac{Y_0}{Y_t}\right)$$

$$K = \frac{(.0833 \text{ ft.})^2 (3.865)}{2(10.2 \text{ ft.})} (8.99 \times 10^{-4} \text{ sec.}^{-1})$$

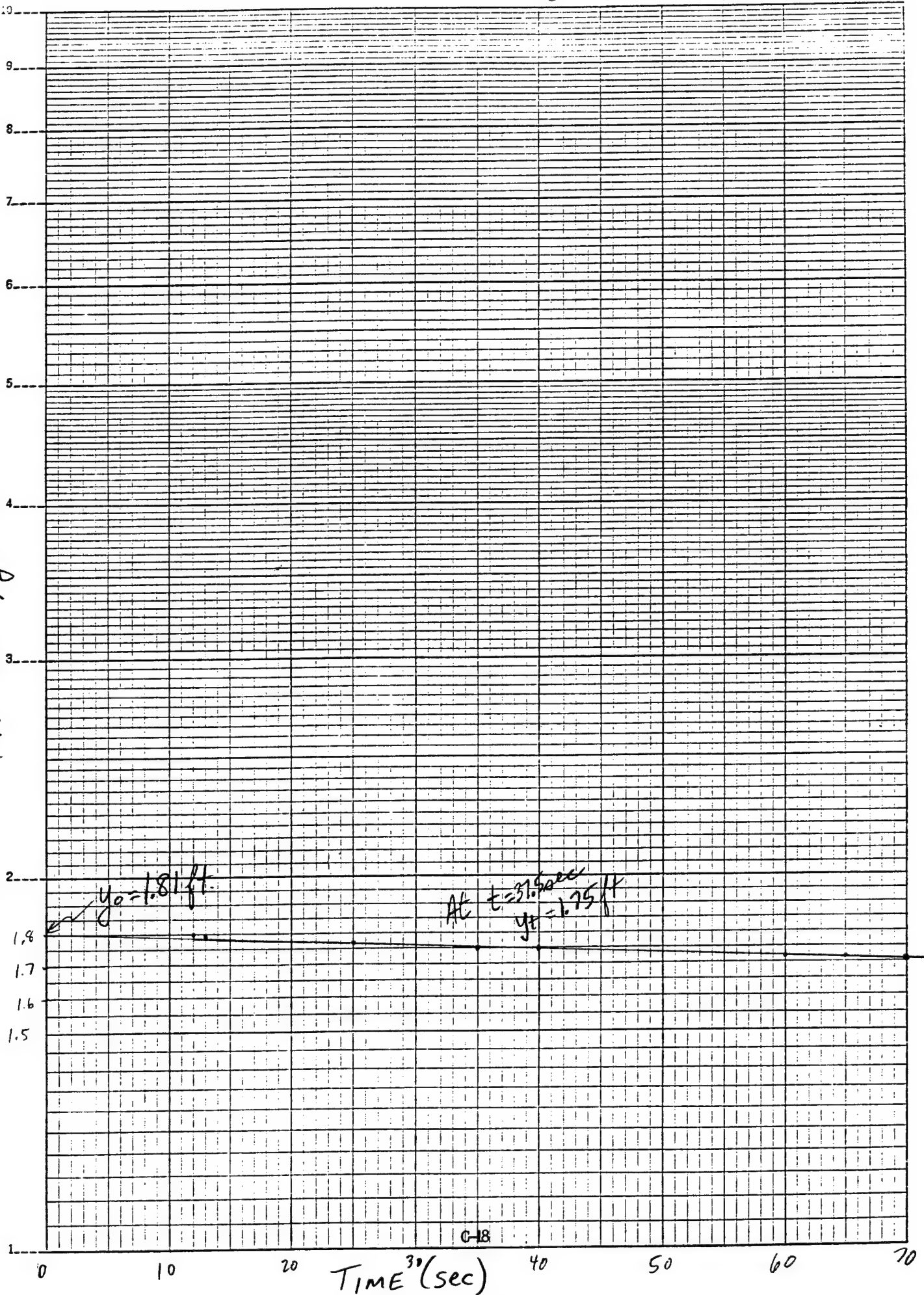
$$K = 1.18 \times 10^{-6} \text{ ft./sec.} = 3.61 \times 10^{-5} \text{ cm/sec.}$$



Well MW 5-02

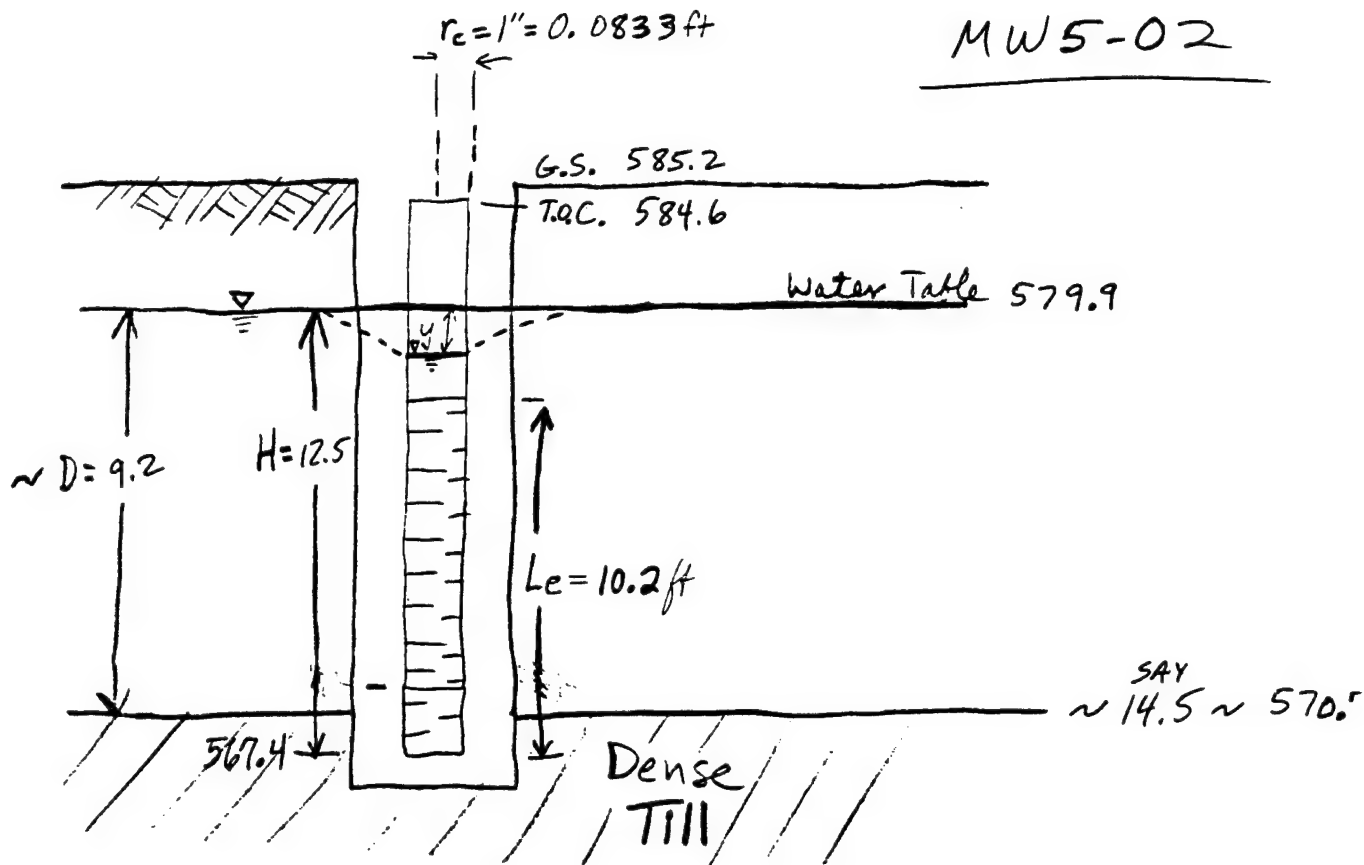
12 1/2" SEMI LOGARITHMIC 4" x 10 1/2"  
1 1/2" CYCLE X 70 DIVISIONS  
KEUFFEL & ESSER CO.

Drawdown,  $y_t$  (ft)



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MW5-02



METCALF & EDDY, ENGINEERS

Using method: Bouwer & Rice, 1976

a) From semi-log plot ( $\log Y_t$  vs  $t$ ) get two slightly linear portions

$$Y_o = 2.17 \text{ ft.}; \text{ at } t = 12 \text{ sec.}, Y_t = 1.80 \text{ ft.}$$

$$(i) Y_o = 1.60 \text{ ft.}; \text{ for } t = 18 \text{ sec.}, Y_t = 1.42 \text{ ft.}$$

$$\frac{1}{t} \ln \frac{Y_o}{Y_t} = \frac{1}{18} \ln \frac{1.60}{1.42} = 6.63 \times 10^{-3} \text{ sec.}^{-1}$$

$$(ii) Y_o = 1.51 \text{ ft.}, \text{ for } t = 35 \text{ sec.}, Y_t = 1.29 \text{ ft.}$$

$$\frac{1}{t} \ln \frac{Y_o}{Y_t} = \frac{1}{35} \ln \frac{1.51}{1.29} = 4.45 \times 10^{-3} \text{ sec.}^{-1}$$

$$b) \frac{L_e}{r_w} = \frac{10.2 \text{ ft.}}{.0833 \text{ ft.}}$$

$$c) \text{ From Figure 3, using } \frac{L}{r_w} = 122.4, C = 4.8$$

d) For fully penetrating well, assume  $D = H$  and use equation (9)

$$\ln \frac{R_e}{r_w} = \left( \frac{1.1}{\ln (13.0/.0833 \text{ ft.})} + \frac{4.8}{10.2 \text{ ft.}/.0833 \text{ ft.}} \right)^{-1} = .02570^{-1} = 3.89$$

$$e) \text{ Using equation (5), } K = \frac{r_c^2 \ln \frac{R_e}{r_w}}{2L} \left( \frac{1}{t} \right) \left( \ln \frac{Y_o}{Y_t} \right)$$

$$(i) K = \frac{(.0833 \text{ ft.})^2 (3.89)}{2(10.2 \text{ ft.})} = 6.63 \times 10^{-3} \text{ sec.}^{-1}$$

$$K = 8.7 \times 10^{-7} \text{ ft./sec.} = 2.66 \times 10^{-4} \text{ cm/sec.}$$

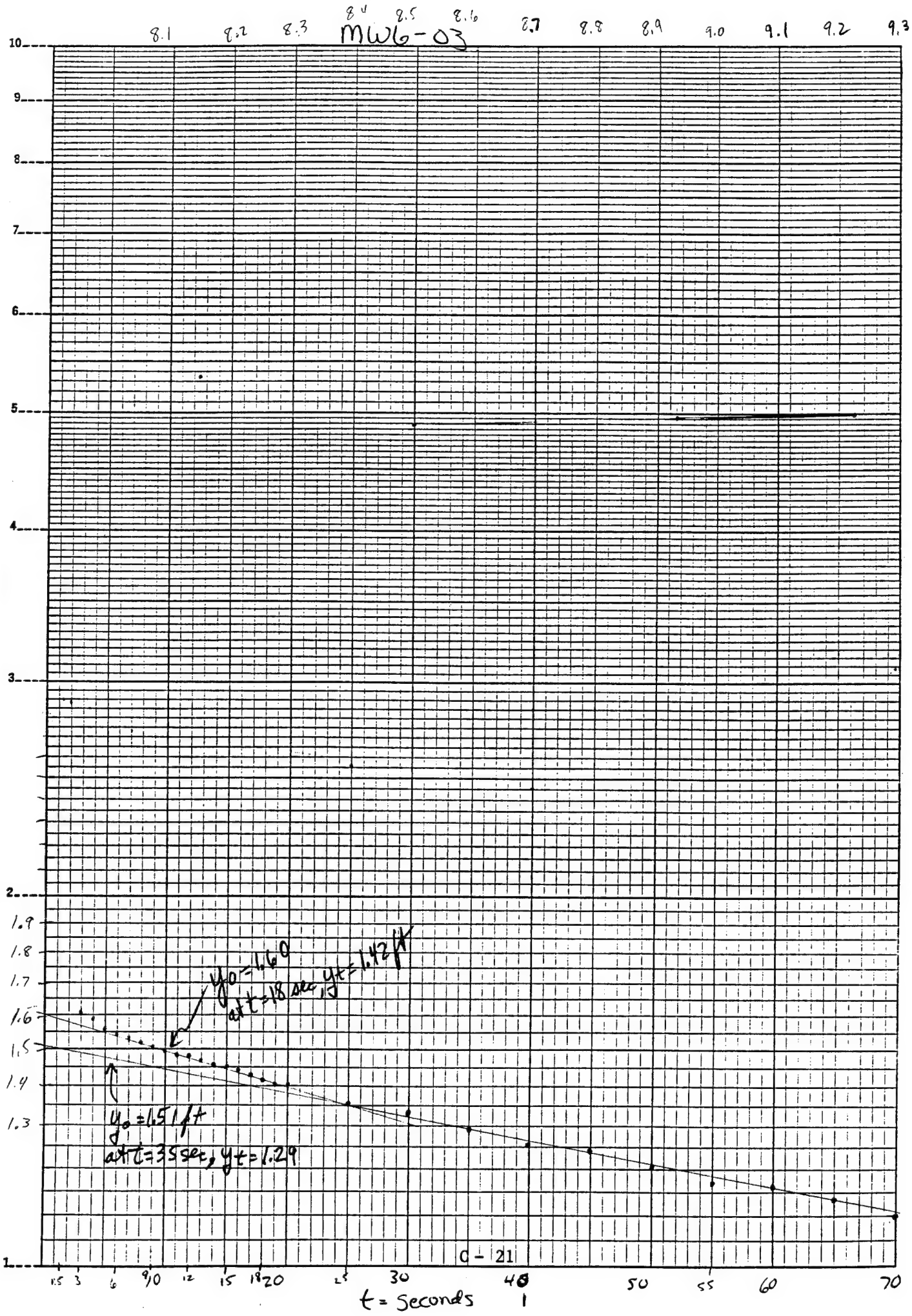
$$(ii) K = \frac{(.0833 \text{ ft.})^2 (3.89)}{2(10.2 \text{ ft.})} (4.45 \times 10^{-3} \text{ sec.}^{-1}) = 5.96 \times 10^{-6} \text{ ft. sec.}$$

$$= 1.8 \times 10^{-4} \text{ cm/sec.}$$

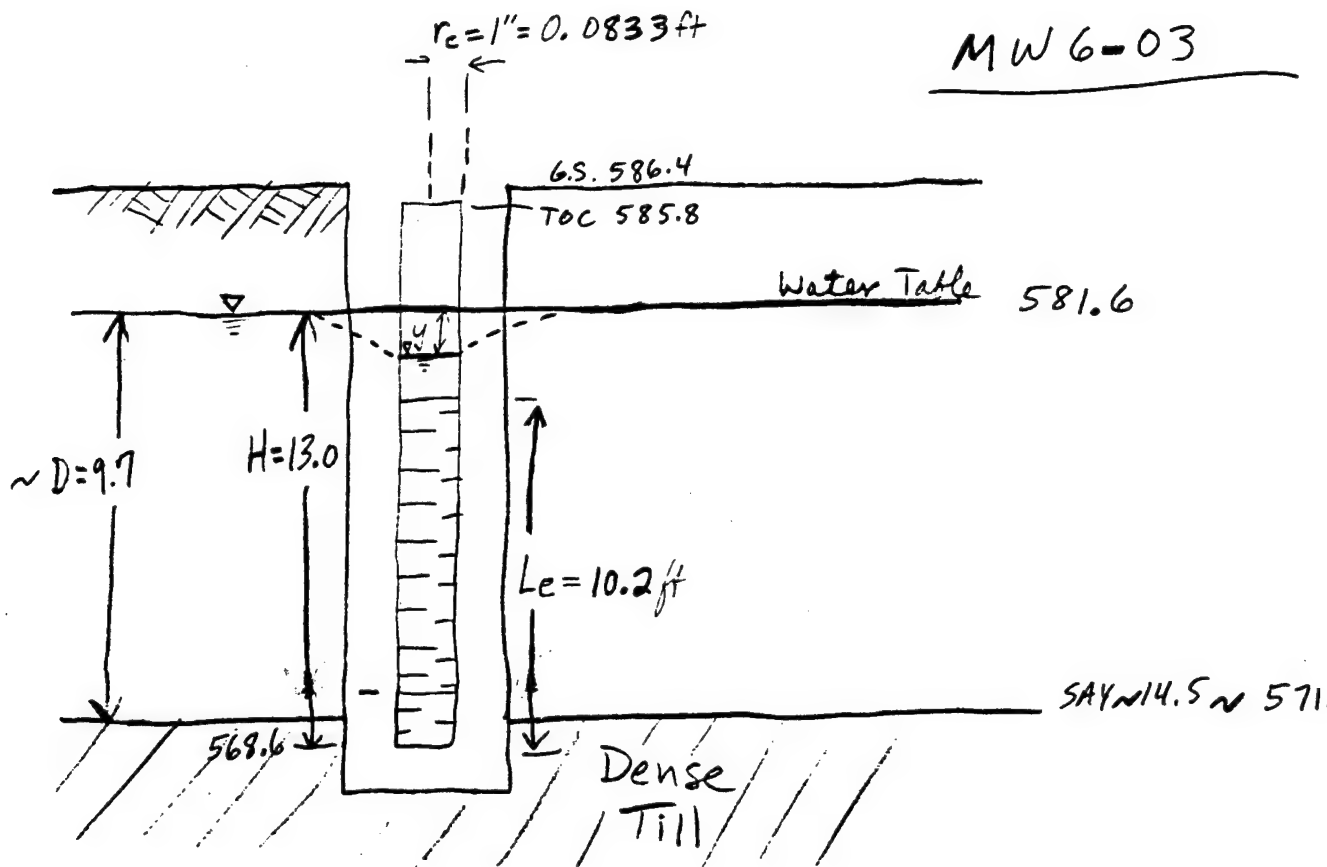
$$\text{average } K = 2 \times 10^{-4} \text{ cm/sec.}$$

Drawdown (ft) m/c

1" = 1 CYCLE X 70 DIVISIONS  
KEUFFEL & ESSER CO.  
MADE IN U.S.A.



MW 6-03



NONREPRODUCIBLE GRID FORM 145

METCALF & EDDY, ENGINEERS

**APPENDIX D**  
**Piezometer/Monitoring Well**  
**Development and Sampling Worksheets**

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers T. Aebie, R. Repinski

Well ID P-1 Date Developed 9/30/90 Time: Start 1310 hr End 1340 hr

Casing Diameter 1.25 inches  $\div 12 = 0.104$  (d) ft. Well secured upon arrival? (Y)N

Depth of well from T.O.C. 19.40 ft. Standing water (gal.) = 0.985

Depth of water from T.O.C. 3.90 ft. x 5 well volumes

Feet of standing water 15.50 (h) ft. = 4.925 gallons to purge

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d^2) + 4] (h) \\ &= 3.14 [(0.104^2) + 4] (15.5 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 0.985 \text{ gals.} \end{aligned}$$

PID Readings (ppm)

Breathing 0.0

Well 0.0

Purging method Bailer Purge: Time Start 1310 hr End 1340 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>5.0</u>	<u>6.93</u>	<u>550</u>	<u>16.2</u>	
2 well volume = <u>6.0</u>	<u>7.00</u>	<u>540</u>	<u>16.1</u>	
3 well volume = <u>11</u>	<u>7.35</u>	<u>550</u>	<u>15.7</u>	
Final volume = <u>12</u>	<u>7.37</u>	<u>530</u>	<u>15.7</u>	

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: (none) sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: (turbid) (silty) sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? Final Sample

Comments Surged with bailer, drawdown observed - 12 gallons bailed.

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers J. Roderick, T. Franc

Well ID P-2 Date Developed 10/9/90 Time: Start 1230 hr End 1250 hr

Casing Diameter 1.25 inches ÷ 12 @ .104 (d)ft. Well secured upon arrival? Y/N

Depth of well from T.O.C. 19.5 ft. Standing water (gal.) = \_\_\_\_\_

Depth of water from T.O.C. 5.3 ft. x \_\_\_\_\_ well volumes

Feet of standing water 14.2 (h) ft. = \_\_\_\_\_ gallons to purge

PID Readings (ppm)

Breathing \_\_\_\_\_

Well \_\_\_\_\_

Standing Water =  $\pi [(d)^2 + 4] (h)$

Volume =  $3.14 [(0.104 \text{ ft})^2 + 4] (\text{ft}) \times 7.48 \text{ gal/ft}^3 = \text{_____ gals.}$

Purging method bailer Purge: Time Start 1230 hr End 1250 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>7.5</u>	<u>7.00</u>	<u>575</u>	<u>13.6</u>	
2 well volume = <u>9.5</u>	<u>7.00</u>	<u>575</u>	<u>13.5</u>	
3 well volume = <u>12</u>	<u>7.00</u>	<u>575</u>	<u>14</u>	
Final volume = _____	_____	_____	_____	

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers J. Roderick, T. Aebie

Well ID P-3 Date Developed 9/30/90 Time: Start 1300 hr End 1330 hr

Casing Diameter 1.25 inches  $\div 12 = 0.104$ (d)ft. Well secured upon arrival? Y/N

Depth of well from T.O.C. 19.3 ft. Standing water (gal.) = 0.843

Depth of water from T.O.C. 6.0 ft. x 5 well volumes

Feet of standing water 13.3 (h)ft. = 4.215 gallons to purge

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d^2) + 4] (h) \\ &= 3.14 [(0.104^2) + 4] (13.3 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 0.843 \text{ gals.} \end{aligned}$$

PID Readings (ppm)

Breathing 0.0

Well 0.0

Purging method Bailer Purge: Time Start 1300 hr End 1330 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>4.5</u>	<u>6.55</u>	<u>550</u>	<u>15.9</u>	
2 well volume = <u>8.5</u>	<u>6.43</u>	<u>525</u>	<u>16.3</u>	
3 well volume = <u>10</u>	<u>7.01</u>	<u>570</u>	<u>15.4</u>	
Final volume = <u>12</u>	<u>7.05</u>	<u>560</u>	<u>15.1</u>	

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? Final Volume

Comments Drawdown observed, 12 gallons bailed.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers J. Roderick, T. Aebie

Well ID P-4 Date Developed 9/30/90 Time: Start 1355 hr End 1435 hr

Casing Diameter 1.25 inches  $\div 12 = 0.104$  (d) ft. Well secured upon arrival? ☒ Y/N

Depth of well from T.O.C. 15.75 ft. silted in Standing water (gal.) = 0.558

Depth of water from T.O.C. 6.95 ft. x 5 well volumes

Feet of standing water 8.80 (h) ft. = 2.790 gallons to purge

Standing Water Volume =  $\pi [(d^2 + 4) (h)]$   
 $= 3.14 [(\frac{1.04^2}{4} + 4) (8.80) \times 7.48 \text{ gal/ft}^3 = 0.558 \text{ gals.}$

PID Readings (ppm)

Breathing 0.0 ppm

Well 0.0

Purging method \_\_\_\_\_ Purge: Time Start \_\_\_\_\_ End \_\_\_\_\_

	pH	Conductivity	Temperature, (C)
1 well volume = <u>4</u> gal.	<u>7.00</u>	<u>810</u>	<u>16.7</u>
2 well volume = <u>7</u> gal.	<u>7.00</u>	<u>790</u>	<u>16.5</u>
3 well volume = <u>8</u> gal.	<u>7.01</u>	<u>790</u>	<u>16.3</u>
Final volume = <u>11.5</u> gal.	<u>7.03</u>	<u>790</u>	<u>16.0</u>

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? Final Volume

Comments 11.5 gallons bailed, recovered peizometer to 15.95 feet.

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers J.L. T. Aebie

Well ID P-5 Date Developed 10/9/90 Time: Start 1140hr End 1250hr

Casing Diameter 1.25 inches ÷ 12 = 0.104 (d)ft. Well secured upon arrival? Y/N

Depth of well from T.O.C. 19.50 ft. Standing water (gal.) = \_\_\_\_\_

Depth of water from T.O.C. 1.45 ft. x \_\_\_\_\_ well volumes

Feet of standing water 18.05 (h)ft. = \_\_\_\_\_ gallons to purge

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [(0.104\text{ft})^2 + 4] (18\text{ ft}) \times 7.48\text{ gal/ft}^3 = \text{_____ gals.} \end{aligned}$$

PID Readings (ppm)

Breathing \_\_\_\_\_

Well \_\_\_\_\_

Purging method Bailer Purge: Time Start 1150hr End 1225hr

		pH	Conductivity	Temperature, (C)
1 well volume =	<u>3</u> gal.	<u>6.70</u>	<u>600</u>	_____
2 well volume =	<u>6</u> gal.	<u>7.08</u>	<u>610</u>	_____
3 well volume =	<u>9</u> gal.	<u>7.03</u>	<u>590</u>	_____
Final volume =	<u>12</u> gal.	<u>7.10</u>	<u>590</u>	<u>15</u>

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers B. Repinski, T. Aehie

Well ID P-6 Date Developed 9/30/90 Time: Start 1400hr End 1445 hr

Casing Diameter 1.25 inches  $\div 12 = 0.104$ (d)ft. Well secured upon arrival? (Y)N

Depth of well from T.O.C. 19.80 ft. Standing water (gal.) = 1.05

Depth of water from T.O.C. 3.30 ft. x 5 well volumes

Feet of standing water 16.50 (h)ft. = 5.25 gallons to purge

Standing Water Volume =  $\pi [(d)^2 + 4] (h)$   
 $= 3.14 [(0.104 \text{ ft})^2 + 4] (16.50 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 1.05 \text{ gals.}$

PID Readings (ppm)  
 Breathing 0.0  
 Well 0.0

Purging method Bailer Purge: Time Start 1400 hr End           

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>5</u>	<u>6.98</u>	<u>820</u>	<u>17.7</u>	
2 well volume = <u>6.5</u>	<u>6.98</u>	<u>790</u>	<u>17.4</u>	
3 well volume = <u>8.0</u>	<u>7.00</u>	<u>780</u>	<u>17.2</u>	
Final volume = <u>9.0</u>	<u>7.00</u>	<u>800</u>	<u>17.0</u>	

Sample Collection: Time Start            End            Bailer ID#           

## Sample Characteristics (Circle all applicable)

Describe odor: (none) sulfide fishy musty petroleum           

Describe color: colorless black (brown) orange red           

Describe appearance: (turbid) (silty) sand clay floaters sheen  
clear multiphased foaming slimy algae           

Organic Layer?            Length?            Samples preserved? Final Volume

Comments 9.0 gallons bailed due to slow recharge, amount stopped  
due to slow recharge and not bailing peizometer dry.

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers J. Roderick

Well ID P-7 Date Developed 10/1/90 Time: Start 0845 hr End 0920 hr

Casing Diameter 1.25 inches  $\div 12 =$  0.104 ft. Well secured upon arrival? (Y/N)

Depth of well from T.O.C. 19.30 ft. silt Standing water (gal.) = 1.04

Depth of water from T.O.C. 2.95 ft. x 5 well volumes

Feet of standing water 16.35 (h) ft. = 5.20 gallons to purge

PID Readings (ppm)

Breathing 0.0

Well 0.0

Standing Water Volume =  $\pi [(d^2 + 4) (h)]$   
 $= 3.14 [(0.104 \text{ ft})^2 + 4] (16.35 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 1.04 \text{ gals.}$

Purging method Bailer Purge: Time Start 0845 hr. End 0920 hr

		pH	Conductivity	Temperature, (C)
1 well volume = <u>3</u> gal.	<u>6.84</u>	<u>625</u>	<u>15.5</u>	
2 well volume = <u>5.5</u> gal.	<u>6.60</u>	<u>695</u>	<u>15.2</u>	
3 well volume = <u>9.0</u> gal.	<u>6.61</u>	<u>710</u>	<u>15.3</u>	
Final volume = <u>10.5</u> gal.	<u>6.68</u>	<u>700</u>	<u>15.2</u>	

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
 clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? Final Volume

Comments Bailed 10.5 gallons, no noticeable water level drop.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers B. Peninski

Well ID P-8 Date Developed 10/1/90 Time: Start 0850 hr End 0925 hr

Casing Diameter 1.25 inches  $\div 12 =$  0.104 (d) ft. Well secured upon arrival? Y/N

Depth of well from T.O.C. 19.77 ft.

Standing water (gal.) = 0.989

Depth of water from T.O.C. 4.20 ft.

x 5 well volumes

Feet of standing water 15.57 (h) ft.

= 4.95 gallons to purge

PID Readings (ppm)

Breathing 0.0

Well 0.0

Standing Water Volume =  $\pi [(d^2 + 4) (h)]$   
 $= 3.14 [(0.104^2 + 4) (15.57) \times 7.48 \text{ gal/ft}^3 = 0.989 \text{ gals.}$

Purging method Bailer Purge: Time Start 0850 hr End 0925 hr

		pH	Conductivity	Temperature, (C)
1 well volume =	<u>3.5</u> gal.	<u>6.50</u>	<u>500</u>	<u>14.7</u>
2 well volume =	<u>7.0</u> gal.	<u>6.35</u>	<u>470</u>	<u>14.9</u>
3 well volume =	<u>11.0</u> gal.	<u>6.30</u>	<u>425</u>	<u>14.8</u>
Final volume =	<u>11.5</u> gal.	<u>6.19</u>	<u>440</u>	<u>14.6</u>

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
 clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers T. Aebie

Well ID MWB-01 Date Developed 10/24/90 Time: Start 0900 hr End 0925 hr

Casing Diameter 2 inches  $\div 12 = .167$  (d) ft. Well secured upon arrival? (Y/N)

Depth of well from T.O.C. 19.1 ft. Standing water (gal.) = 2.78

Depth of water from T.O.C. 2.1 ft. x 5 well volumes

Feet of standing water 17.0 (h) ft. = 13.9 gallons to purge

Standing Water Volume =  $\pi [(d)^2 + 4] (h)$   
 $= 3.14 [(.167^2 + 4)] (17 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 2.78 \text{ gals.}$

PID Readings (ppm)

Breathing 0.0

Well 0.0

Purging method B-K pump Purge: Time Start 0900 hr End 0925 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>3</u> gal	<u>gal.</u>	<u>6.30</u>	<u>550</u>	<u>14.9</u>
2 well volume = <u>9</u> gal	<u>gal.</u>	<u>6.68</u>	<u>575</u>	<u>15.3</u>
3 well volume = <u>12</u> gal	<u>gal.</u>	<u>7.0</u>	<u>580</u>	<u>15.1</u>
Final volume = <u>16</u> gal	<u>gal.</u>	<u>7.3</u>	<u>575</u>	<u>15.2</u>

Sample Collection: Time Start 0920 hr End 0925 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: (none) sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black (brown) orange red  
tan

Describe appearance: (turbid) (silty) sand clay floaters sheen  
clear multiphased foaming slimy algae

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments Purged 16 gallons, recovery good.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers T. Aebie

Well ID MW1-06 Date Developed 10/24/90 Time: Start 1210 hr End 1300 hr

Casing Diameter 2 inches  $\div 12 = .167$  (d)ft. Well secured upon arrival? ☒ Y ☐ N

Depth of well from T.O.C. 19.0 ft. Standing water (gal.) = 2.62

Depth of water from T.O.C. 3.0 ft. x 5 well volumes

Feet of standing water 16.0 (h)ft. = 13.1 gallons to purge

Standing Water Volume =  $\pi [(d^2) + 4] (h)$   
 $= 3.14 [(.167^2) + 4] (16 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 2.62 \text{ gals.}$

PID Readings (ppm)

Breathing 0.0

Well 3.0

Purging method B-K Purge: Time Start 1210 hr End 1255 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>3</u>	<u>gal.</u>	<u>7.29</u>	<u>500</u>	<u>16.3</u>
2 well volume = <u>6</u>	<u>gal.</u>	<u>7.27</u>	<u>525</u>	<u>16.5</u>
3 well volume = <u>9</u>	<u>gal.</u>	<u>7.21</u>	<u>510</u>	<u>16.3</u>
Final volume = <u>13</u>	<u>gal.</u>	<u>7.22</u>	<u>500</u>	<u>16.2</u>

Sample Collection: Time Start 1255 hr End 1300 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
 clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments Slow recovery, purge slow to keep from bailing dry.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_



# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers T. Aebie  
 Well ID MW2-04 Date Developed 10/24/90 Time: Start 1130 hr End 1200 hr  
 Casing Diameter 2 inches ÷ 12 = .167 (d) ft. Well secured upon arrival? (Y/N)  
 Depth of well from T.O.C. 19.65 ft. Standing water (gal.) = 2.82  
 Depth of water from T.O.C. 2.40 ft. x 5 well volumes  
 Feet of standing water 17.25 (h) ft. = 14.1 gallons to purge

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [(.167 \text{ ft})^2 + 4] (17.25 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 2.82 \text{ gals.} \end{aligned}$$

PID Readings (ppm)

Breathing 0.0

Well 3.0

Purging method B-K Pump Purge: Time Start 1130 hr End 1155 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>3</u>	<u>gal.</u>	<u>7.20</u>	<u>510</u>	<u>18.0</u>
2 well volume = <u>6</u>	<u>gal.</u>	<u>7.31</u>	<u>520</u>	<u>17.4</u>
3 well volume = <u>9</u>	<u>gal.</u>	<u>7.37</u>	<u>540</u>	<u>17.1</u>
Final volume = <u>13</u>	<u>gal.</u>	<u>7.31</u>	<u>520</u>	<u>17.3</u>
<u>14</u>		<u>7.45</u>	<u>510</u>	<u>17.0</u>

Sample Collection: Time Start 1150 hr End 1155 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: (none) sulfide fishy musty petroleum \_\_\_\_\_  
 Describe color: (colorless) black (brown) orange red \_\_\_\_\_  
 Describe appearance: (turbid) silty sand clay floaters sheen  
(clear) multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers T. Aebie

Well ID MW4-05 Date Developed 10/24/90 Time: Start 1310 hr End 1405 hr

Casing Diameter 2 inches  $\div 12 = .167$  (d)ft. Well secured upon arrival? ☒ Y ☐ N

Depth of well from T.O.C. 19.75 ft. Standing water (gal.) = 2.88

Depth of water from T.O.C. 2.15 ft. x 5 well volumes

Feet of standing water 17.60 (h)ft. = 14.4 gallons to purge

Standing Water Volume =  $\pi [(d^2 + 4) (h)]$   
 $= 3.14 [(.167^2 + 4) (17.6 \text{ ft}) \times 7.48 \text{ gal/ft}^3] = 2.88 \text{ gals.}$

PID Readings (ppm)

Breathing 0

Well 2.0

Purging method B-K Purge: Time Start 1315 hr End 1405 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>3</u>		<u>6.77</u>	<u>660</u>	<u>17.2</u>
2 well volume = <u>6</u>		<u>6.99</u>	<u>650</u>	<u>17.1</u>
3 well volume = <u>9</u>		<u>6.60</u>	<u>620</u>	<u>17.6</u>
Final volume = <u>13</u>		<u>7.2</u>	<u>625</u>	<u>17.0</u>
<u>14</u>		<u>6.90</u>	<u>640</u>	<u>17.1</u>

Sample Collection: Time Start 1400 hr End 1405 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments Slow recovery, purged slow, cleaned right up.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No 005907- Developers T. Aebie

Well ID MW5-02 Date Developed 10/24/90 Time: Start 0950 hr End 1015 hr

Casing Diameter 2" inches  $\div 12 = .167$  (d)ft. Well secured upon arrival? (Y/N)

Depth of well from T.O.C. 19.7 ft. Standing water (gal.) = 2.4

Depth of water from T.O.C. 5.1 ft. x 5 well volumes

Feet of standing water 14.6 (h)ft. = 12 gallons to purge

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [(.167 \text{ ft})^2 + 4] (14.6 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = 2.40 \text{ gals.} \end{aligned}$$

PID Readings (ppm)

Breathing 0.0

Well 2.5

Purging method B-K pump Purge: Time Start 0950 hr End 1015 hr

		pH	Conductivity	Temperature, (C)
1 well volume = <u>3 gal</u>	gal.	<u>6.64</u>	<u>525</u>	<u>18.3</u>
2 well volume = <u>6 gal</u>	gal.	<u>6.60</u>	<u>550</u>	<u>17.9</u>
3 well volume = <u>9 gal</u>	gal.	<u>6.79</u>	<u>550</u>	<u>18.0</u>
Final volume = <u>12 gal</u>	gal.	<u>7.20</u>	<u>550</u>	<u>17.6</u>

Sample Collection: Time Start 1010 hr End 1015 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid little silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments Good recovery.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## WELL DEVELOPMENT WORKSHEET

Job Name Hulman ANG Job No. 005907 Developers T. Aebie

Well ID MW6-03 Date Developed 10/24/90 Time: Start 1035 hr End 1100 hr

Casing Diameter 2 inches  $\div 12 =$  .167 (d)ft. Well secured upon arrival? ☒ Y ☐ N

Depth of well from T.O.C. 19.8 ft. Standing water (gal.) = 2.36

Depth of water from T.O.C. 5.4 ft. x 5 well volumes

Feet of standing water 14.4 (h) ft. = 11.8 gallons to purge

Standing Water =  $\pi [(d)^2 \div 4] (h)$

$$\text{Volume} = 3.14 \left[ \left( \frac{1.67 \text{ ft}}{2} \right)^2 + 4 \right] \frac{(14.4 \text{ ft}) \times 7.48 \text{ gal/ft}^3}{4} = 2.36 \text{ gals}$$

PID Readings (ppm)

Breathing 0.0

Well 0.1

Purging method B-K Pump Purge: Time Start 1040 hr End 1100hr

1 well volume = 3 gal. pH 6.4 Conductivity 620 Temperature, (C) 17.3

2 well volume = 8 gal. 6.3 620 16.8

3 well volume = 11 gal. 6.53 640 16.7

Final volume = 14 gal. 6.3 610 16.6

Sample Collection: Time Start 1055 hr End 1056 hr Bailer ID# \_\_\_\_\_

**Sample Characteristics (Circle all applicable)**

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color:      colorless      black      brown      orange      red  
   tan

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae

Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments	Slow recovery, purged 14 gallons before sample.
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# WELL SAMPLING WORKSHEET

Job Name Hulman Job No. 005907 Samplers KW/LS

Well ID MWB-01 Date Sampled 11/9/90 Time: Start 1400 hr End 1650 hr

Casing Diameter 2 inches  $\div 12 = .16$  (d)ft. Well secured upon arrival? (Y/~~N~~)

Depth of well from T.O.C. 19.22 ft.

Depth of water from T.O.C. 2.44 ft.

Feet of standing water 16.78 (h)ft.

Standing water (gal.) = 2.52

x 3 well volumes

= 7.56 gallons to purge

OVA  
~~NO~~ Readings (ppm)

Breathing 0

Well 0

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [(.16 \text{ ft})^2 + 4] (16.78 \text{ ft}) \times 7.48 \text{ gal/ft}^3 = \underline{2.52} \text{ gals.} \end{aligned}$$

Purging method bailer Purge: Time Start 1520 hr End 1550 hr

	gal.	pH	Conductivity	Temperature, (C)
1 well volume = <u>2.52</u>	<u>gal.</u>	<u>6.65</u>	<u>500 um/c</u>	<u>56°F</u>
2 well volume = <u>5.0</u>	<u>gal.</u>	<u>6.80</u>	<u>500</u>	<u>57°F</u>
3 well volume = <u>7.5</u>	<u>gal.</u>	<u>6.82</u>	<u>550</u>	<u>58°F</u>
Final volume = _____	<u>gal.</u>	<u>7.40</u>	<u>539</u>	<u>56°F</u>

Sample Collection: Time Start 1550 hr End 1610 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: (none) sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black (lt. brown) orange red \_\_\_\_\_

Describe appearance: (turbid) silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? No Length? N/A Samples preserved? Yes

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# WELL SAMPLING WORKSHEET

Job Name Hulman Job No. \_\_\_\_\_ Samplers LS KW

Well ID MW1-06 Date Sampled 11/11/90 Time: Start 0815 hr End 0920 hr

Casing Diameter 2 inches + 12 = .16 (d)ft. Well secured upon arrival? (Y/N)

Depth of well from T.O.C. 19.35 ft. (finish) Standing water (gal.) = 2.6

Depth of water from T.O.C. 3.34 ft. (12.74) x 3 well volumes

Feet of standing water 16.01 (h)ft. = 8.3 gallons to purge

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [( \text{ft} )^2 + 4] ( \text{ft} ) \times 7.48 \text{ gal/ft}^3 = \text{gals.} \end{aligned}$$

OVA ~~PHX~~ Readings (ppm)

Breathing 0

Well 0

Purging method bailer Purge: Time Start 0840 hr End 0900 hr

	gal.	pH	Conductivity	Temperature, <del>(XX)</del> (F)
1 well volume = <u>2.5</u>	<u>gal.</u>	<u>5.47</u>	<u>625</u>	<u>57°F</u>
2 well volume = <u>5.0</u>	<u>gal.</u>	<u>6.06</u>	<u>660</u>	<u>58°F</u>
3 well volume = <u>7.5</u>	<u>gal.</u>	<u>6.41</u>	<u>650</u>	<u>58°F</u>
Final volume = _____	<u>gal.</u>	<u>7.02</u>	<u>600</u>	<u>59°F</u>

Sample Collection: Time Start 0900 hr End 0920 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy (mild musty) petroleum \_\_\_\_\_

Describe color: 1st 2 bailers (colorless) black (brown) orange red \_\_\_\_\_

Describe appearance: (turbid) (silty) sand clay floaters sheen \_\_\_\_\_

clear multiphased foaming slimy algae \_\_\_\_\_

No headspace reading on first bailer

Organic Layer? no Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments top 2 bailers - clear

then got very silty

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

# WELL SAMPLING WORKSHEET

Job Name Hulman ANG Job No. 005907 Samplers L Spence & K. Walter

Well ID MW2-04 Date Sampled 11/9/90 Time: Start 1715 hr End 1830 hr

Casing Diameter 2 inches + 12 = 1/6 (d)ft. Well secured upon arrival? Y/N

Depth of well from T.O.C. 19.51 ft. Standing water (gal.) = 2.8

Depth of water from T.O.C. 2.60 ft. x 3 well volumes

Feet of standing water 16.91 (h)ft. = 8.3 gallons to purge

OVA  
~~NO~~ Readings (ppm)

Breathing .25 ppm

Well 2 ppm

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [( \text{ft} )^2 + 4] ( \text{ft} ) \times 7.48 \text{ gal/ft}^3 = \text{gals.} \end{aligned}$$

Purging method bailer Purge: Time Start 1720 hr End 1805 hr

		pH	Conductivity	Temperature, <del>(XX)</del> (F)
1 well volume =	<u>3</u> gal.	<u>7.30</u>	<u>600</u>	<u>61°F</u>
2 well volume =	<u>6</u> gal.	<u>7.21</u>	<u>575</u>	<u>60°F</u>
3 well volume =	<u>9</u> gal.	<u>7.40</u>	<u>600</u>	<u>59°F</u>
Final volume =	gal.	<u>7.38</u>	<u>575</u>	<u>59°F</u>

Sample Collection: Time Start 1810 hr End 1830 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: (none) sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red grey

Describe appearance: (turbid) silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? no Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# WELL SAMPLING WORKSHEET

Job Name HULMAN ANG Job No. 005907 Samplers LS KW

Well ID MW4-05 Date Sampled 11/11/90 Time: Start 1000 hr End 1055 hr

Casing Diameter 2 inches  $\div 12 = \frac{1}{6}$  (d) ft. Well secured upon arrival? (Y/N)

Depth of well from T.O.C. 19.71 ft.

Standing water (gal.) = 2.7

Depth of water from T.O.C. 3.30 ft.

x 3 well volumes

Feet of standing water 16.41 (h) ft.

= 8.1 gallons to purge

OVA

~~PM~~ Readings (ppm)

Breathing .5

Well 100

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [(\text{ft})^2 + 4] (\text{ft}) \times 7.48 \text{ gal/ft}^3 = \text{gals.} \end{aligned}$$

Purging method bailer Purge: Time Start 1025 hr End 1050 hr

	gal.	pH	Conductivity	Temperature, (F)
1 well volume = <u>2.75</u>	<u>gal.</u>	<u>7.13</u>	<u>775</u>	<u>60°F</u>
2 well volume = <u>5.5</u>	<u>gal.</u>	<u>6.60</u>	<u>700</u>	<u>60°F</u>
3 well volume = <u>8.25</u>	<u>gal.</u>	<u>6.82</u>	<u>650</u>	<u>61°F</u>
Final volume = _____	<u>gal.</u>	<u>6.86</u>	<u>650</u>	<u>61°F</u>

Sample Collection: Time Start 1050 hr End 1055 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: (none) sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black (lt. brown) orange red \_\_\_\_\_

Describe appearance: turbid (silty) sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? No Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments No floating product - headspace initial bailer = 0  
1st two bailers clear, then turned lt. brown, but  
still fairly clear  
\_\_\_\_\_  
\_\_\_\_\_



# WELL SAMPLING WORKSHEET

Job Name Hulman Job No. 005907 Samplers L. Spence & K. Walter

Well ID MW5-02 Date Sampled 11/11/90 Time: Start 1230 hr End 1430 hr

Casing Diameter 2 inches  $\div 12 = \underline{1/6}$  (d) ft. Well secured upon arrival? (Y)N

Depth of well from T.O.C. 19.61 ft. Standing water (gal.) = 2.4

Depth of water from T.O.C. 5.12 ft. x 3 well volumes

Feet of standing water 14.49 (h) ft. = 7.3 gallons to purge

OVA

~~NO~~ Readings (ppm)

Breathing 0 ppm

Well 2 ppm

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [( \underline{\quad} \text{ft} )^2 + 4] ( \underline{\quad} \text{ft} ) \times 7.48 \text{ gal/ft}^3 = \underline{\quad} \text{gals.} \end{aligned}$$

Purging method bailer Purge: Time Start 1320 hr End 1330 hr

		pH	Conductivity	Temperature, <del>(XX)</del> (F)
1 well volume =	<u>2.5</u> gal.	<u>6.11</u>	<u>680</u>	<u>65°F</u>
2 well volume =	<u>5.0</u> gal.	<u>6.32</u>	<u>725</u>	<u>64°F</u>
3 well volume =	<u>7.5</u> gal.	<u>6.51</u>	<u>725</u>	<u>64°F</u>
Final volume =	<u>        </u> gal.	<u>6.64</u>	<u>650</u>	<u>64°F</u>

Sample Collection: Time Start 1330 hr End 1430 hr Bailer ID#         

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum         

Describe color: colorless black (brown light orange) red         

Describe appearance: (slightly turbid) silty sand clay floaters sheen           
clear multiphased foaming slimy algae         

Organic Layer? No Length?          Samples preserved?         

Comments Water noted between the well and the outer casing to a level  
just below well top.

# WELL SAMPLING WORKSHEET

Job Name Hulman Job No. 005907 Samplers K. Walter L. Spence

Well ID MW6-03 Date Sampled 11/11/90 Time: Start 1550 hr End 1650 hr

Casing Diameter 2 inches  $\div 12 =$  .16 (d)ft. Well secured upon arrival? (Y/N)

Depth of well from T.O.C. 19.65 ft.

Standing water (gal.) = 2.3

Depth of water from T.O.C. (5.82) ft.

x 3 well volumes

Feet of standing water 13.83 (h) ft.

= 6.9 gallons to purge

OVA

~~PH~~ Readings (ppm)

Breathing 0

Well 0

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [( \text{ft} )^2 + 4] ( \text{ft} ) \times 7.48 \text{ gal/ft}^3 = \text{gals.} \end{aligned}$$

Purging method bailer Purge: Time Start 1555 hr End 1615 hr

	gal.	pH	Conductivity	Temperature, <del>(C)</del> (F)
1 well volume = <u>2.25</u>	<u>gal.</u>	<u>6.80</u>	<u>875</u>	<u>61°F</u>
2 well volume = <u>4.50</u>	<u>gal.</u>	<u>6.60</u>	<u>800</u>	<u>63°F</u>
3 well volume = <u>6.75</u>	<u>gal.</u>	<u>6.90</u>	<u>800</u>	<u>62°F</u>
Final volume = _____	<u>gal.</u>	<u>6.53</u>	<u>750</u>	<u>62°F</u>

Sample Collection: Time Start 1630 hr End 1650 hr Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

Organic Layer? No Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

Comments \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# WELL SAMPLING WORKSHEET

Job Name Hulman Job No. 005907 Samplers EJD MD

Well ID MWA-08 Date Sampled 11/9/90 Time: Start 1330 hr End 1550 hr

Casing Diameter \_\_\_\_\_ inches ÷ 12 = \_\_\_\_\_ (d)ft. Well secured upon arrival? Y/N

Depth of well from T.O.C. \_\_\_\_\_ ft. Standing water (gal.) = \_\_\_\_\_

Depth of water from T.O.C. \_\_\_\_\_ ft. x \_\_\_\_\_ well volumes

Feet of standing water \_\_\_\_\_ (h)ft. = \_\_\_\_\_ gallons to purge

$$\begin{aligned} \text{Standing Water Volume} &= \pi [(d)^2 + 4] (h) \\ &= 3.14 [( \text{ft} )^2 + 4] ( \text{ft} ) \times 7.48 \text{ gal/ft}^3 = \text{gals.} \end{aligned}$$

PID Readings (ppm)

Breathing \_\_\_\_\_

Well \_\_\_\_\_

Purging method \_\_\_\_\_ Purge: Time Start \_\_\_\_\_ End \_\_\_\_\_

	pH	Conductivity	Temperature, (C)(F)
1 well volume = _____ gal.	_____	_____	_____
2 well volume = _____ gal.	_____	_____	_____
3 well volume = _____ gal.	_____	_____	_____
Final volume = _____ gal.	<u>6.8</u>	<u>650</u>	<u>59°F</u>

Sample Collection: Time Start \_\_\_\_\_ End \_\_\_\_\_ Bailer ID# \_\_\_\_\_

## Sample Characteristics (Circle all applicable)

Describe odor: none sulfide fishy musty petroleum \_\_\_\_\_

Describe color: colorless black brown orange red \_\_\_\_\_

Describe appearance: turbid silty sand clay floaters sheen  
clear multiphased foaming slimy algae \_\_\_\_\_

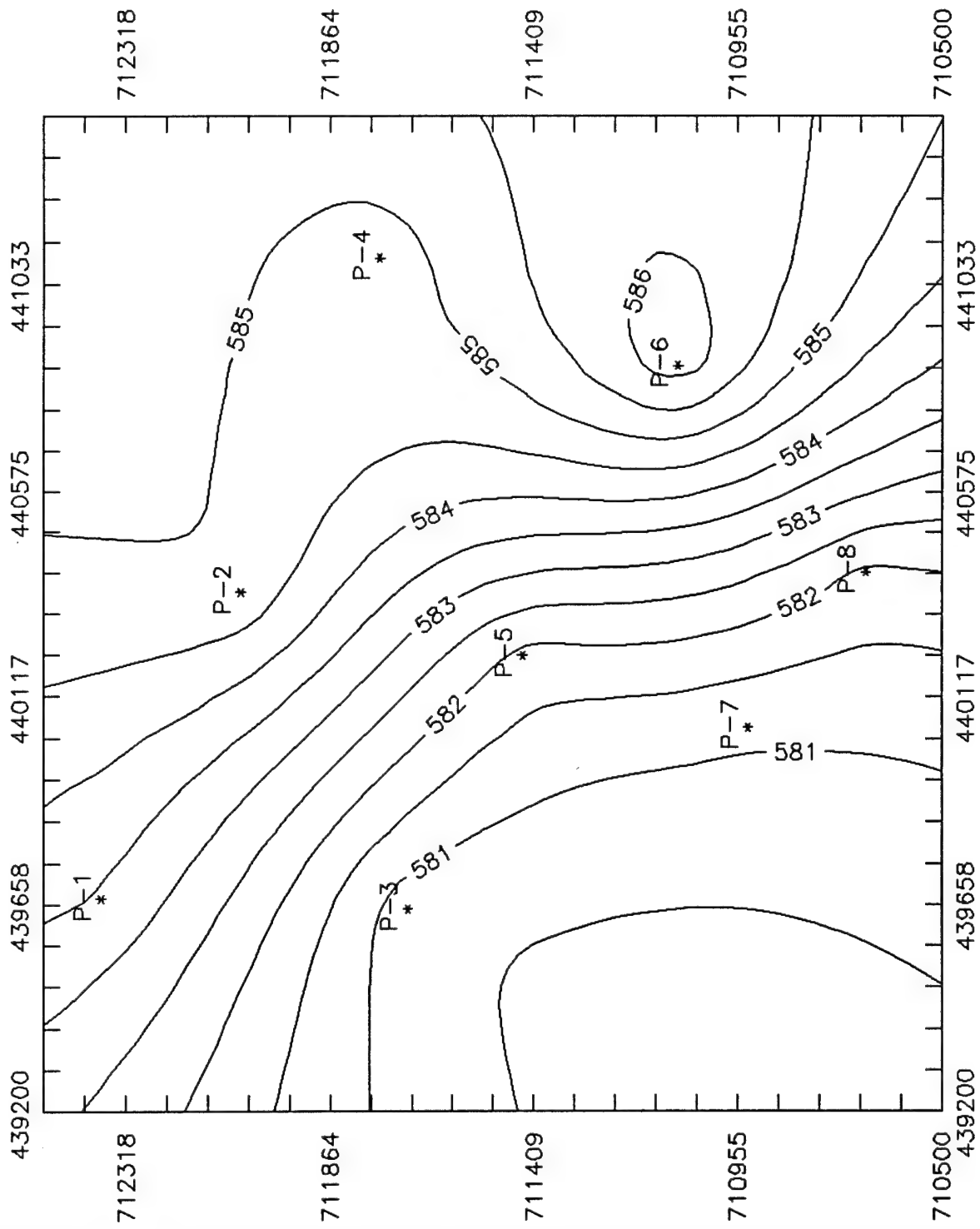
Organic Layer? \_\_\_\_\_ Length? \_\_\_\_\_ Samples preserved? \_\_\_\_\_

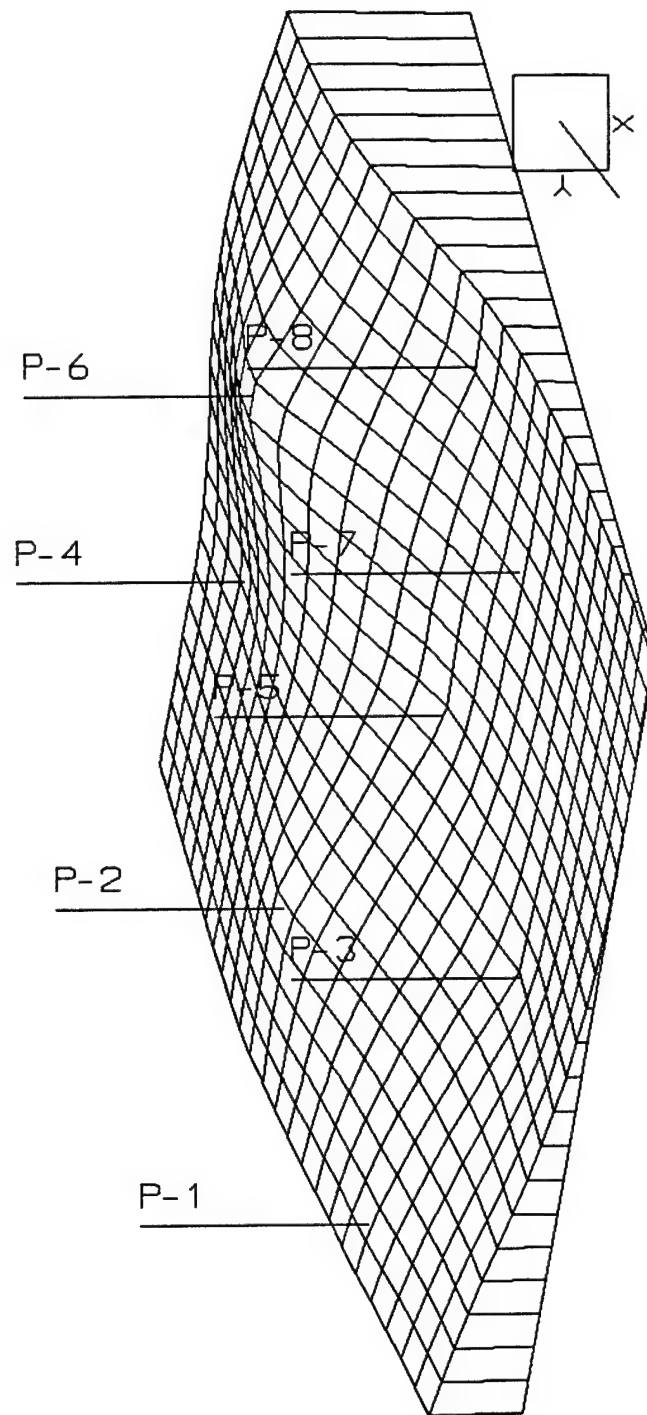
Comments This is the water supply well at the Ammo area purges for five minutes and then sampled one aliquot taken after purging.

Well characs forthcoming from CE dept.

**APPENDIX E**  
**Piezometric Surface and Till Contours**

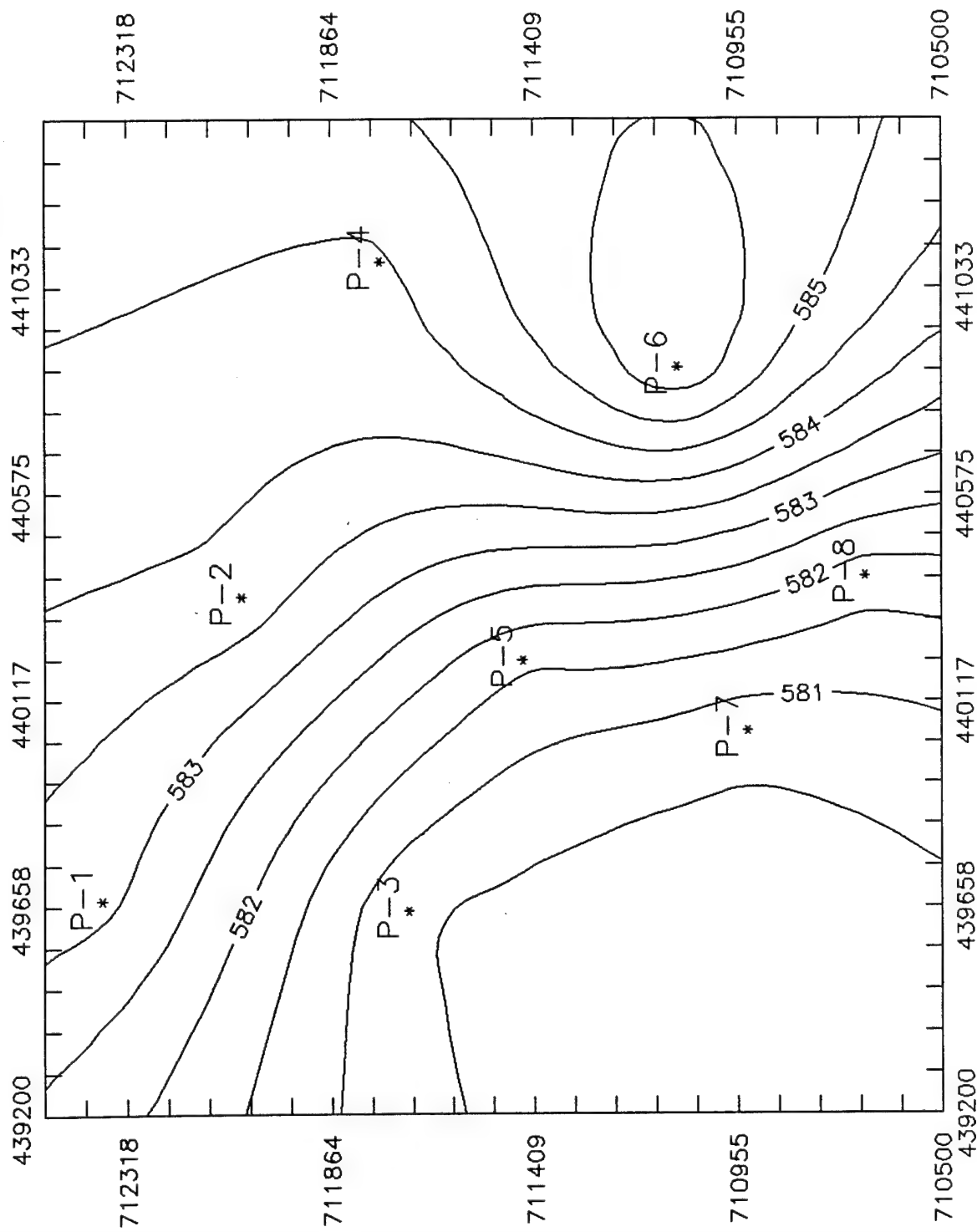
# HULMAN PIEZOMETRIC DATA OCTOBER 14, 1990



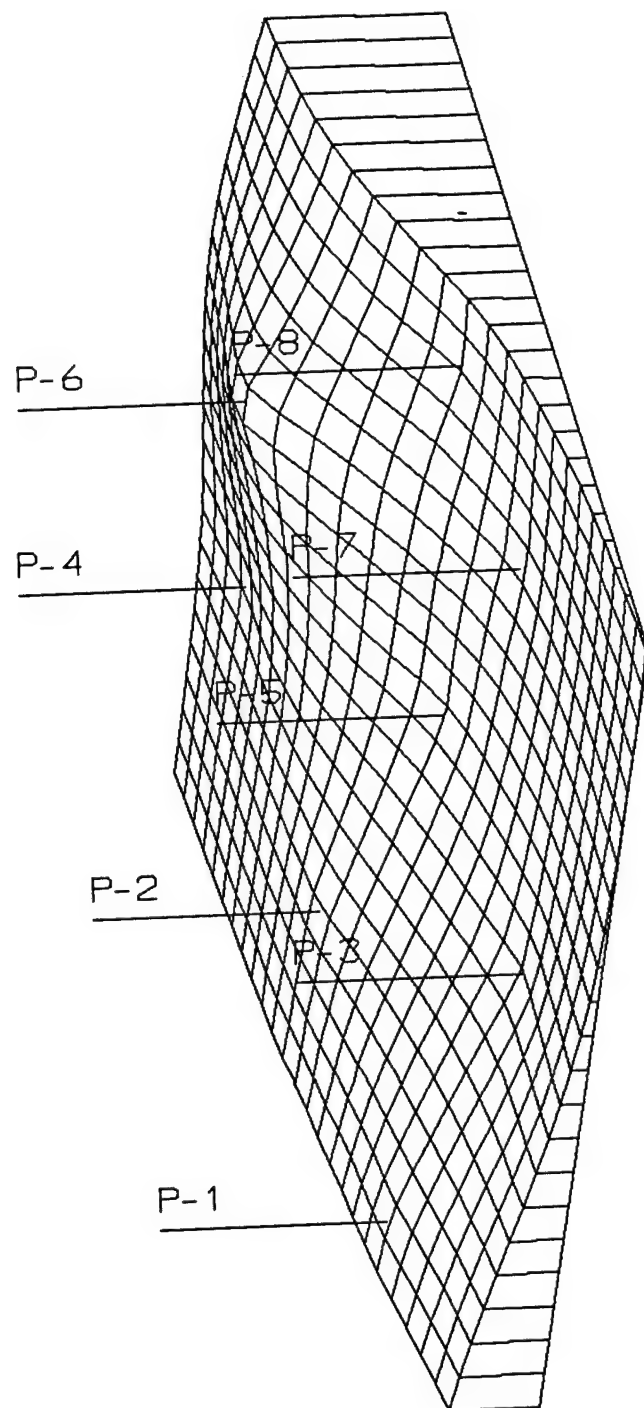


HULMAN PIEZOMETRIC SURFACE OCTOBER 14, 1992

# HULMAN PIEZOMETRIC DATA OCTOBER 16, 1990



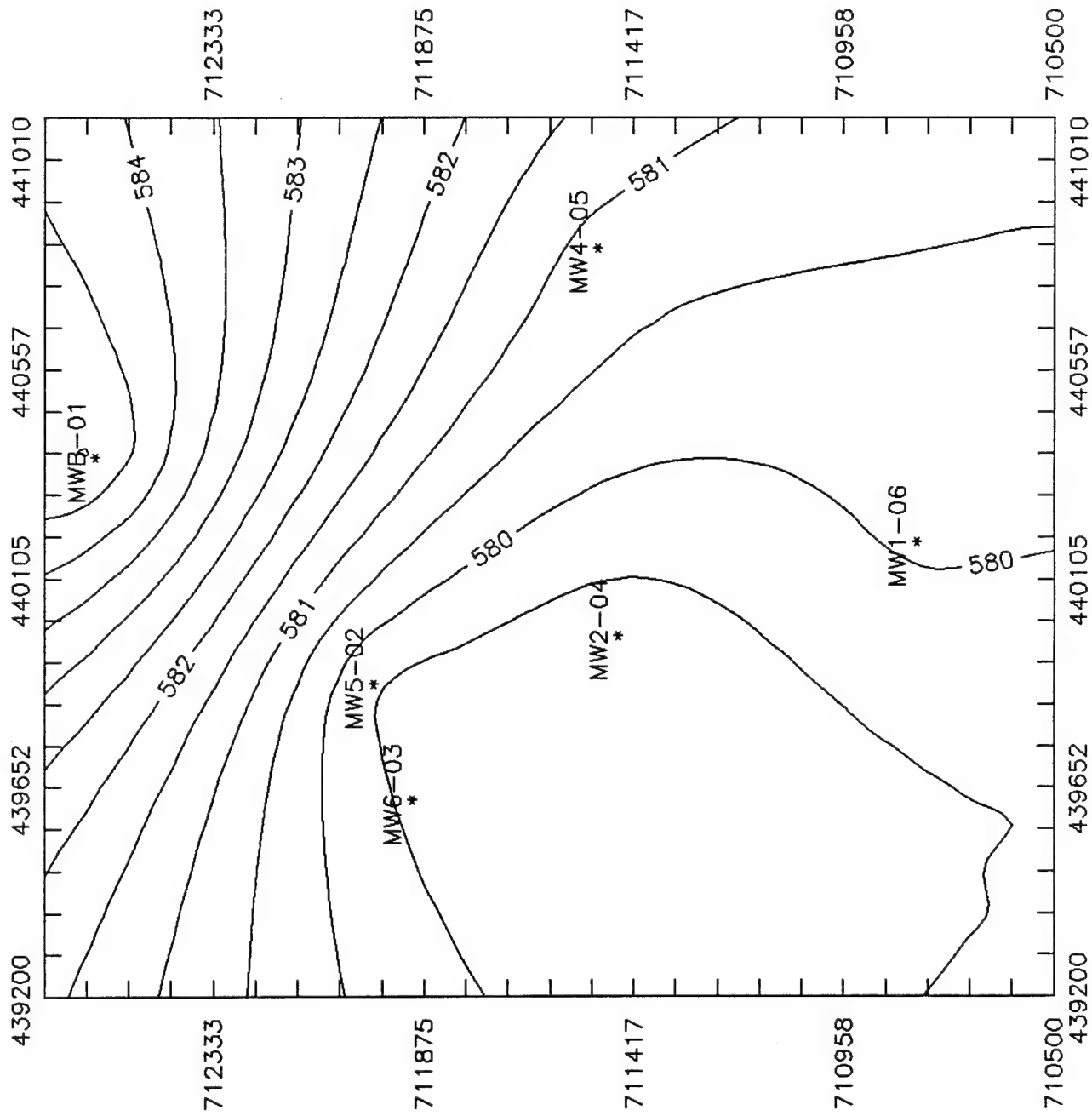
SCALE 1:350

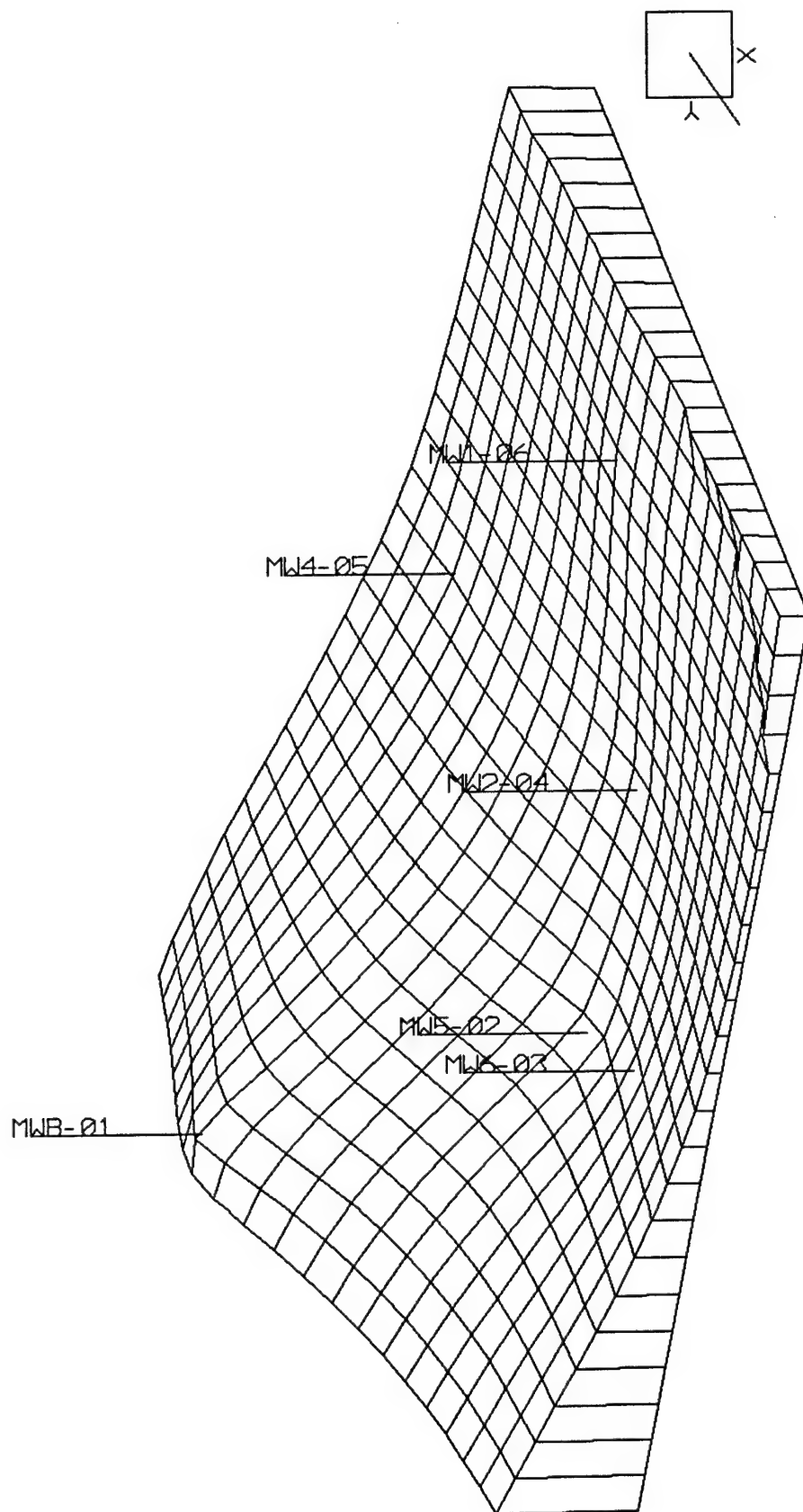


HULMAN PIEZOMETRIC SURFACE OCTOBER 16, 1990



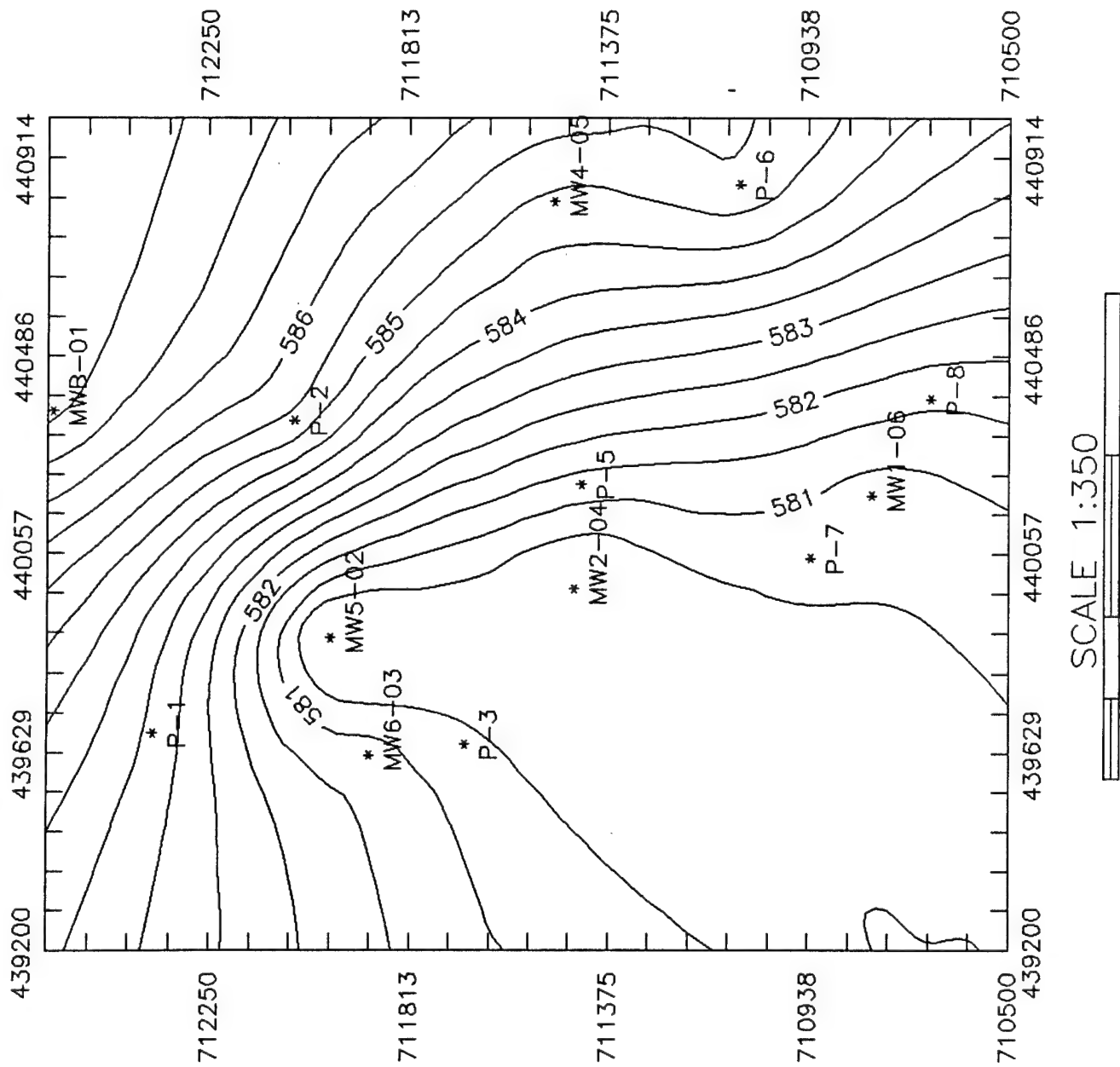
# HULMAN PIEZOMETRIC DATA NOVEMBER 9, 1990

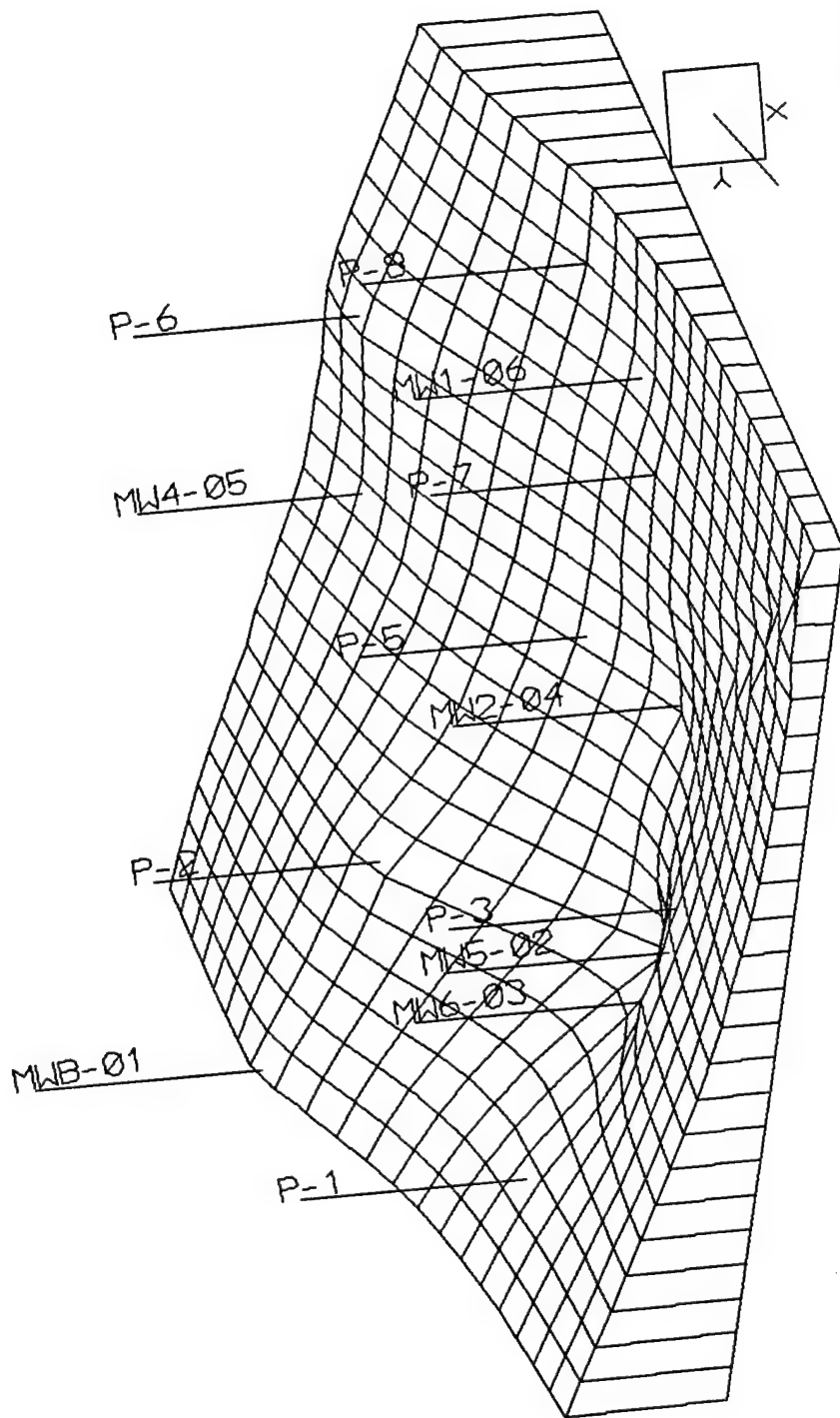




HULMAN PIEZOMETRIC SURFACE NOVEMBER 9, 1990

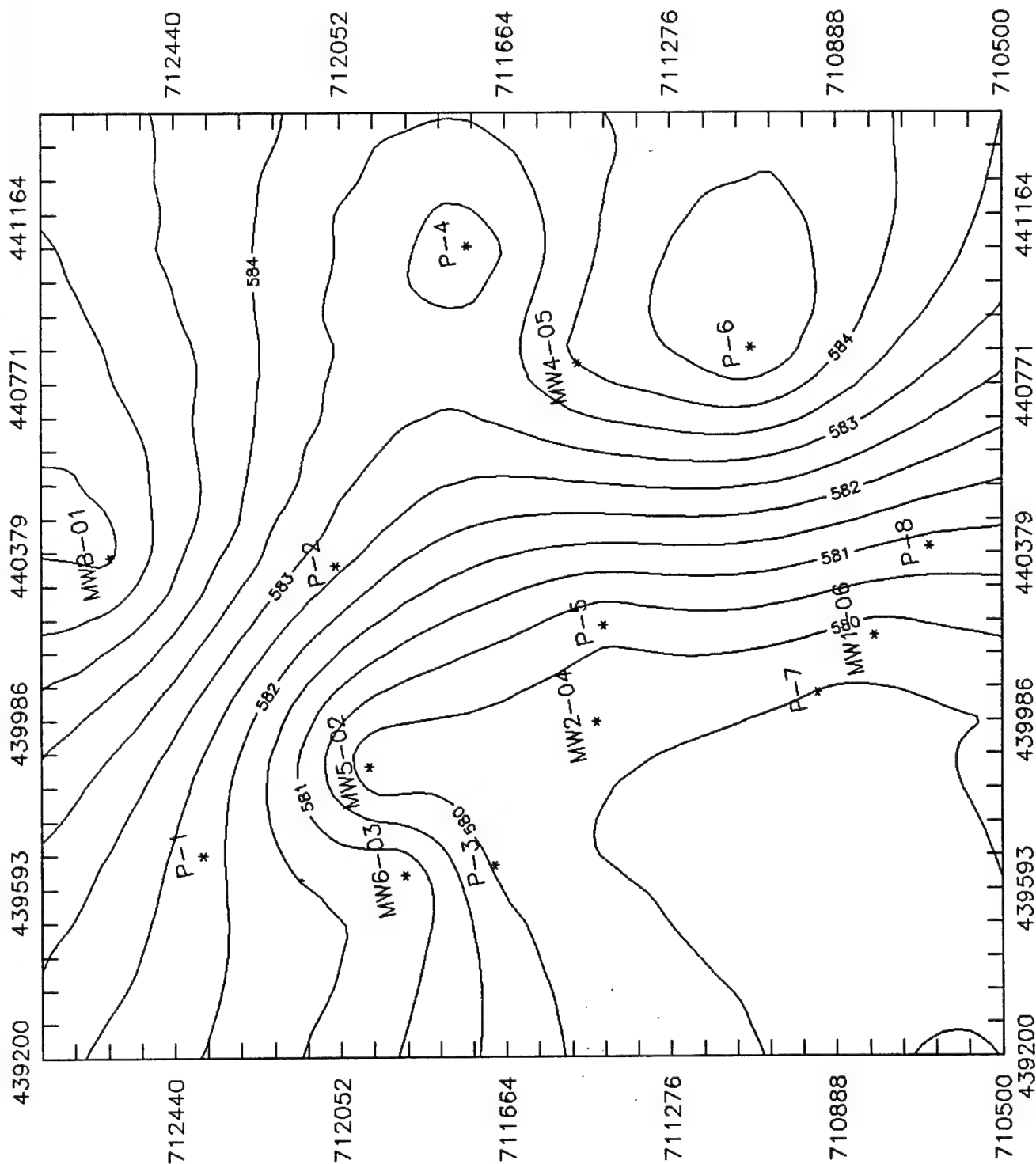
# HULMAN PEIZOMETRIC DATA FEBRUARY 20, 1991



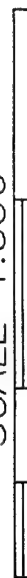


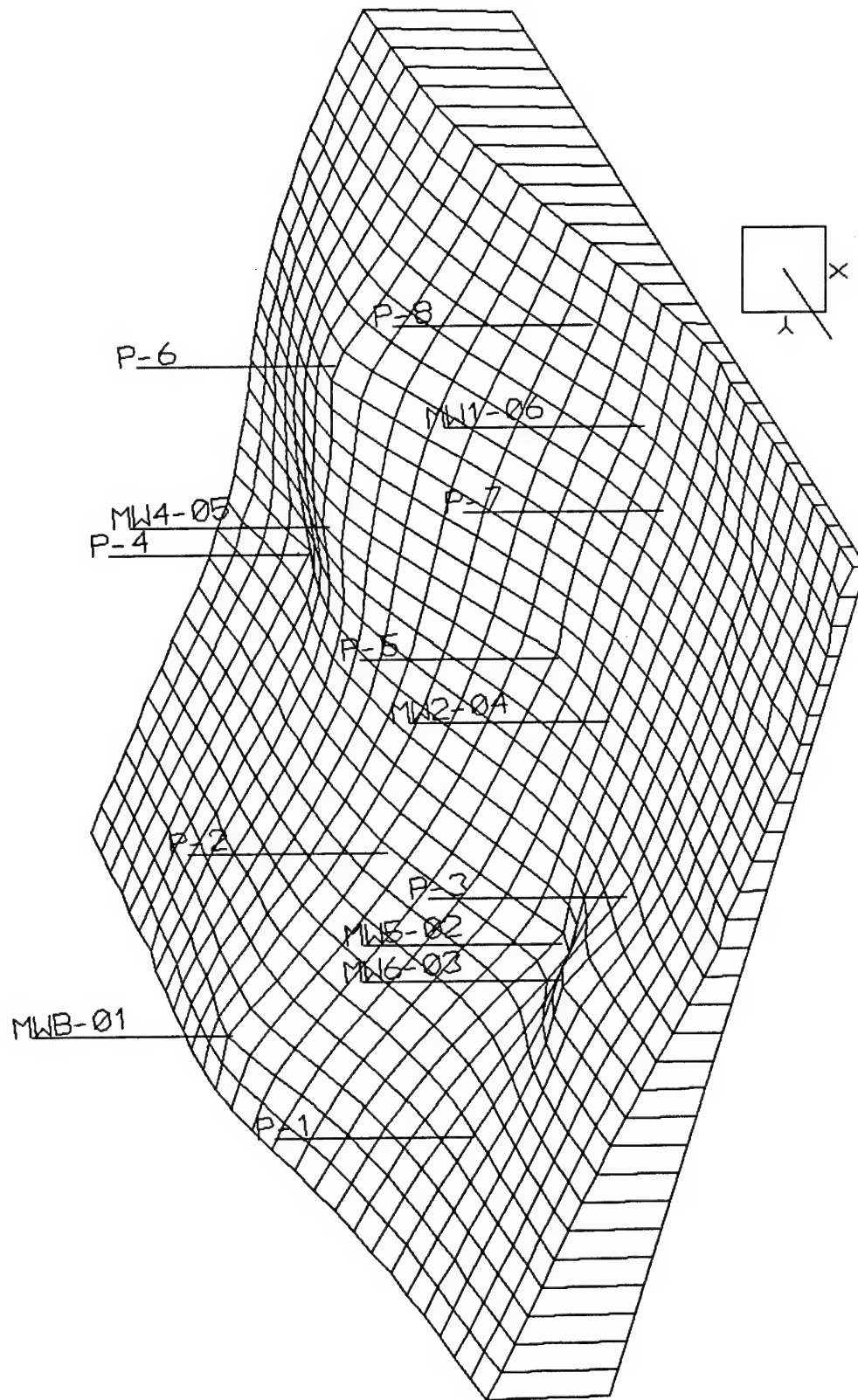
HULMAN PIEZOMETRIC SURFACE FEBRUARY 20, 1991

# HULMAN PIEZOMETRIC DATA JUNE 27, 1991



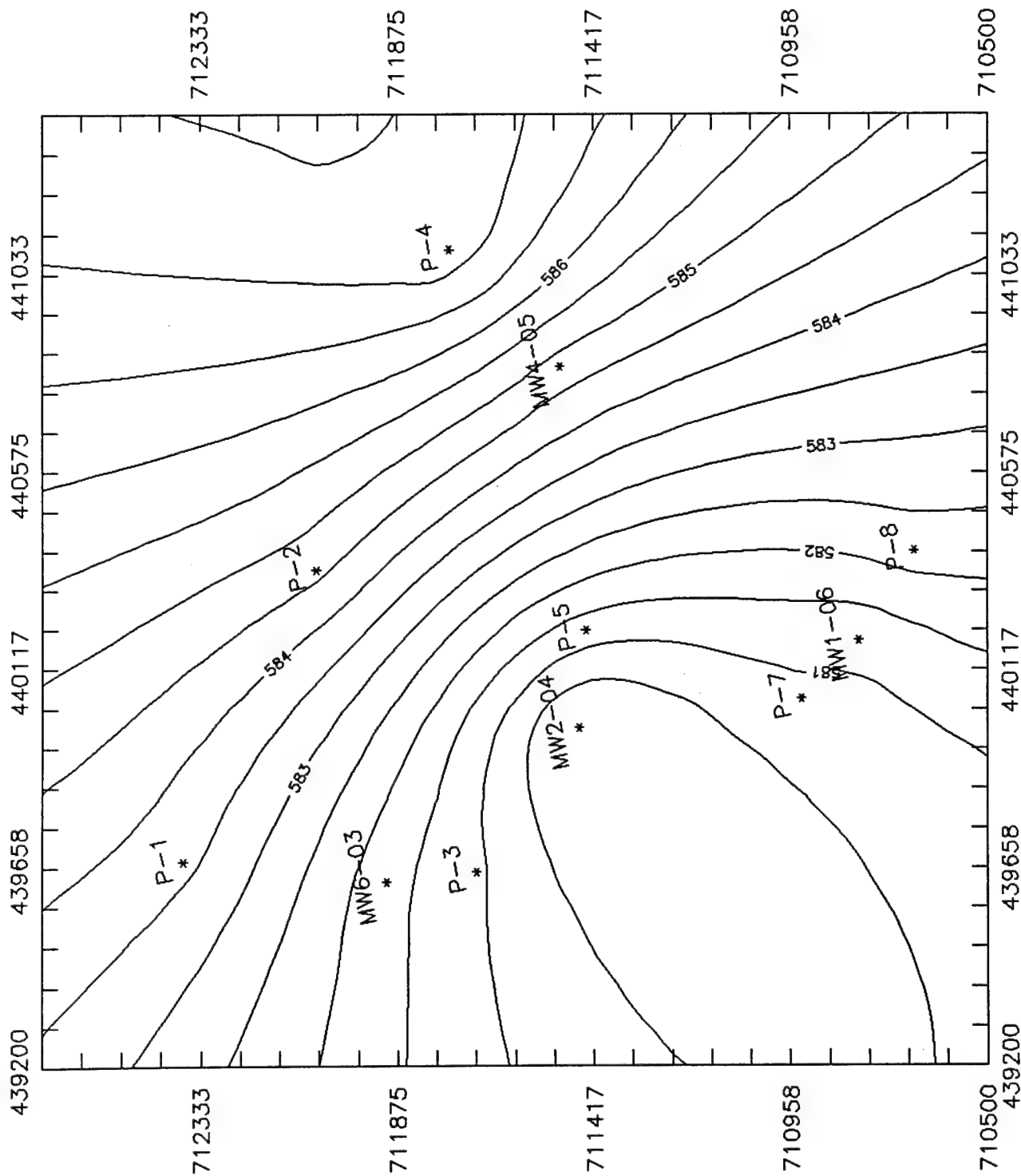
SCALE 1:350



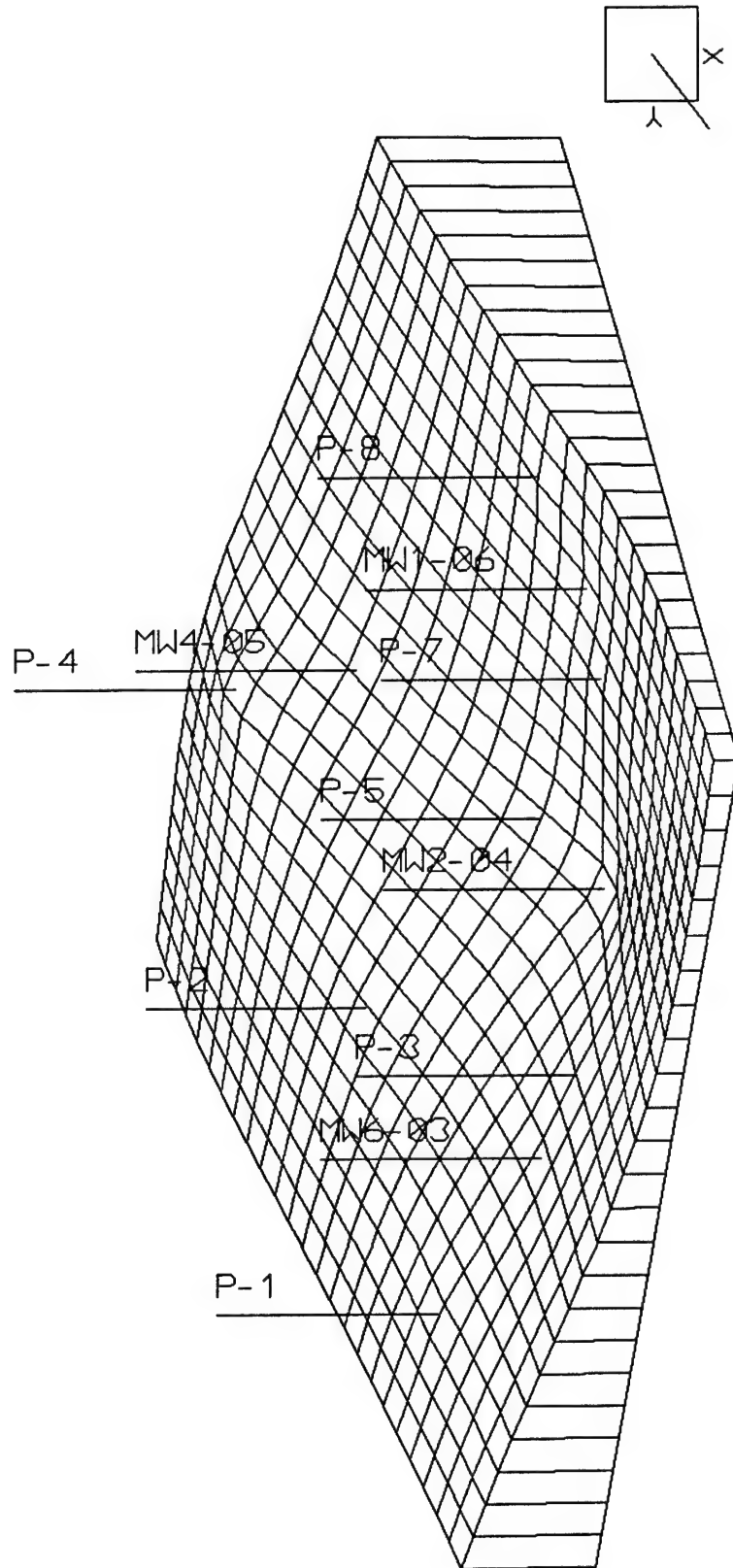


HULMAN PIEZOMETRIC SURFACE JUNE 27, 1991

# HULMAN PIEZOMETRIC DATA JANUARY 17, 1992



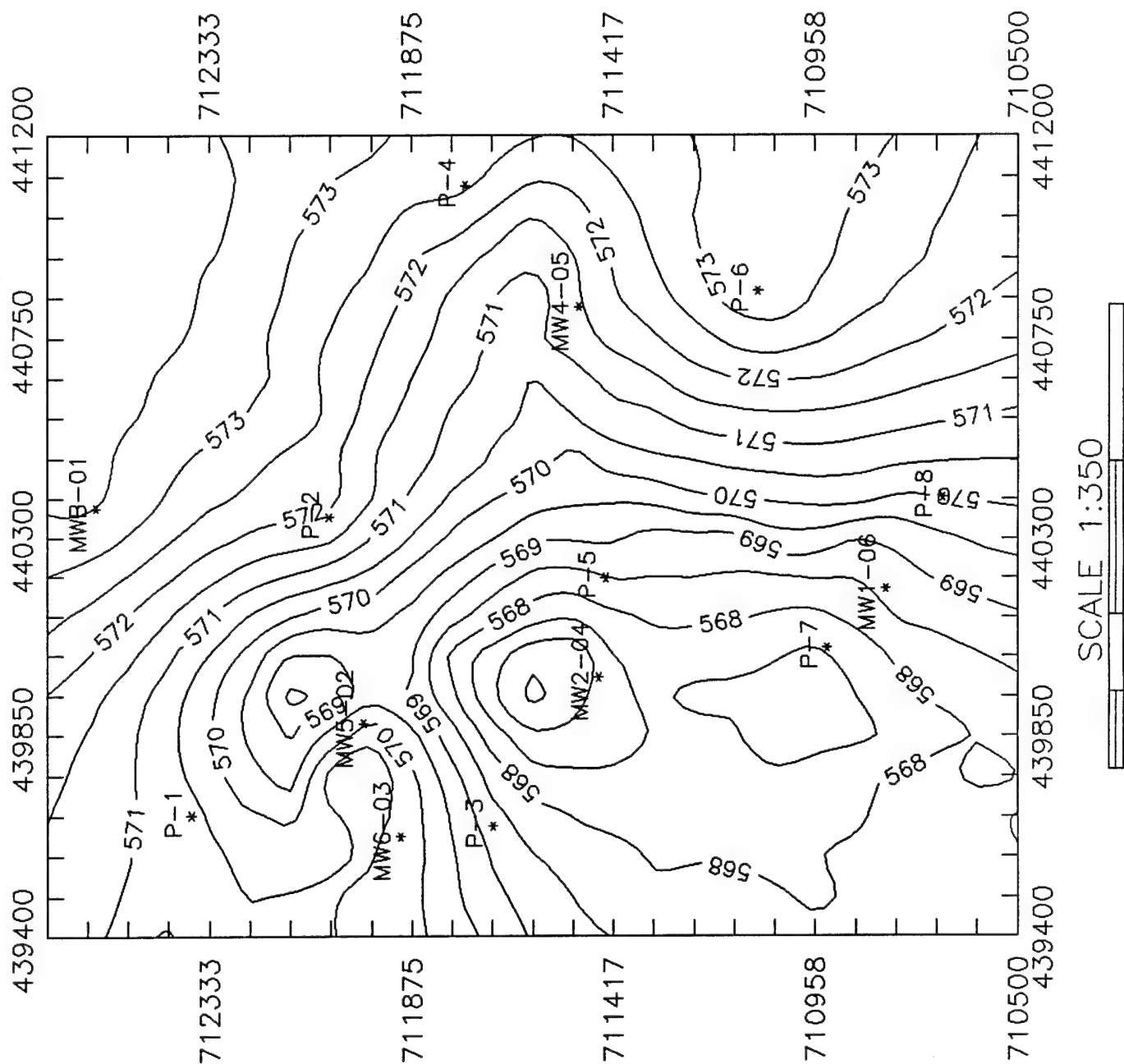
SCALE 1:350

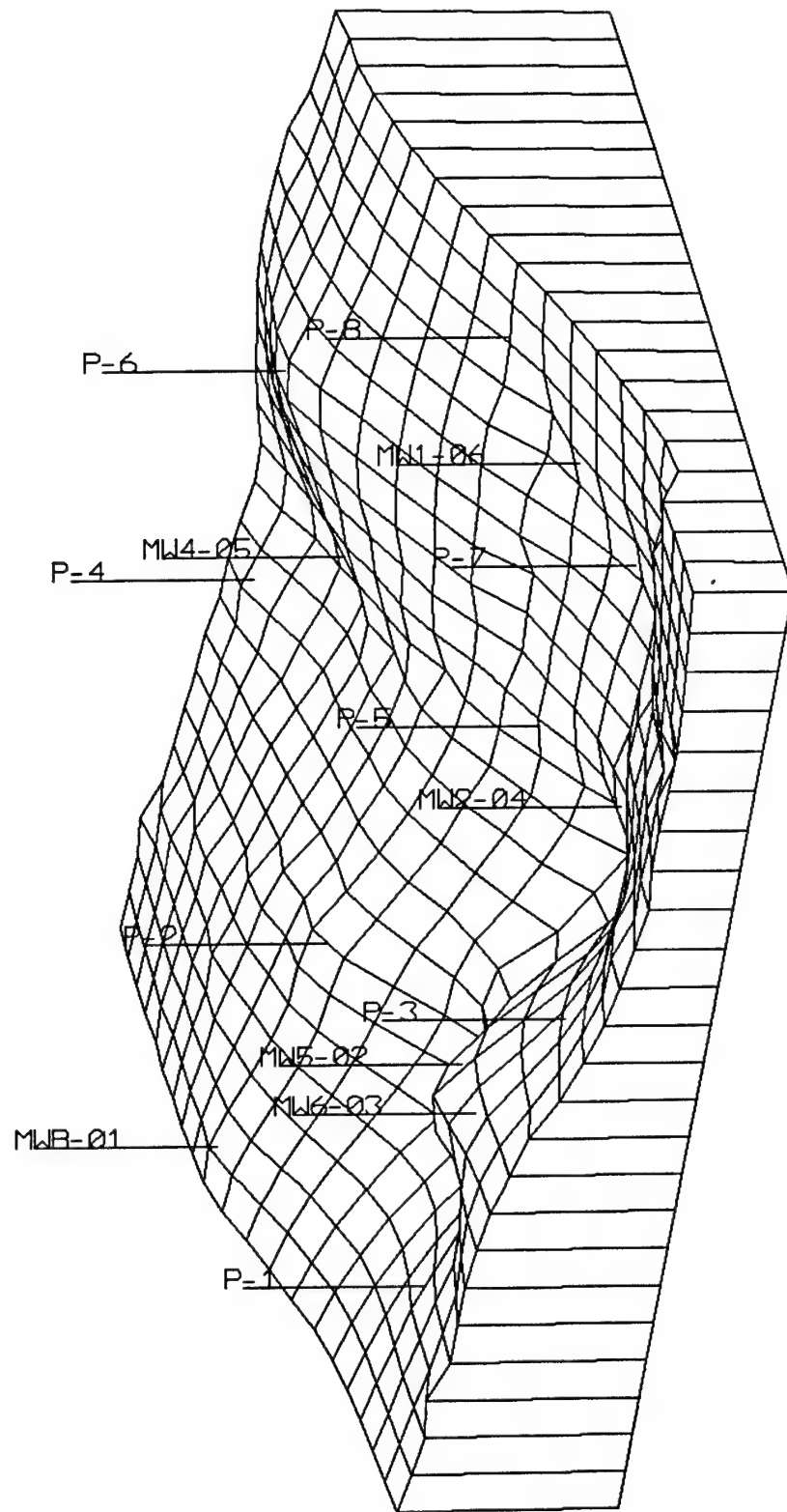
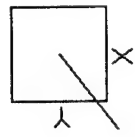


HULMAN PIEZOMETRIC SURFACE JANUARY 17, 1992



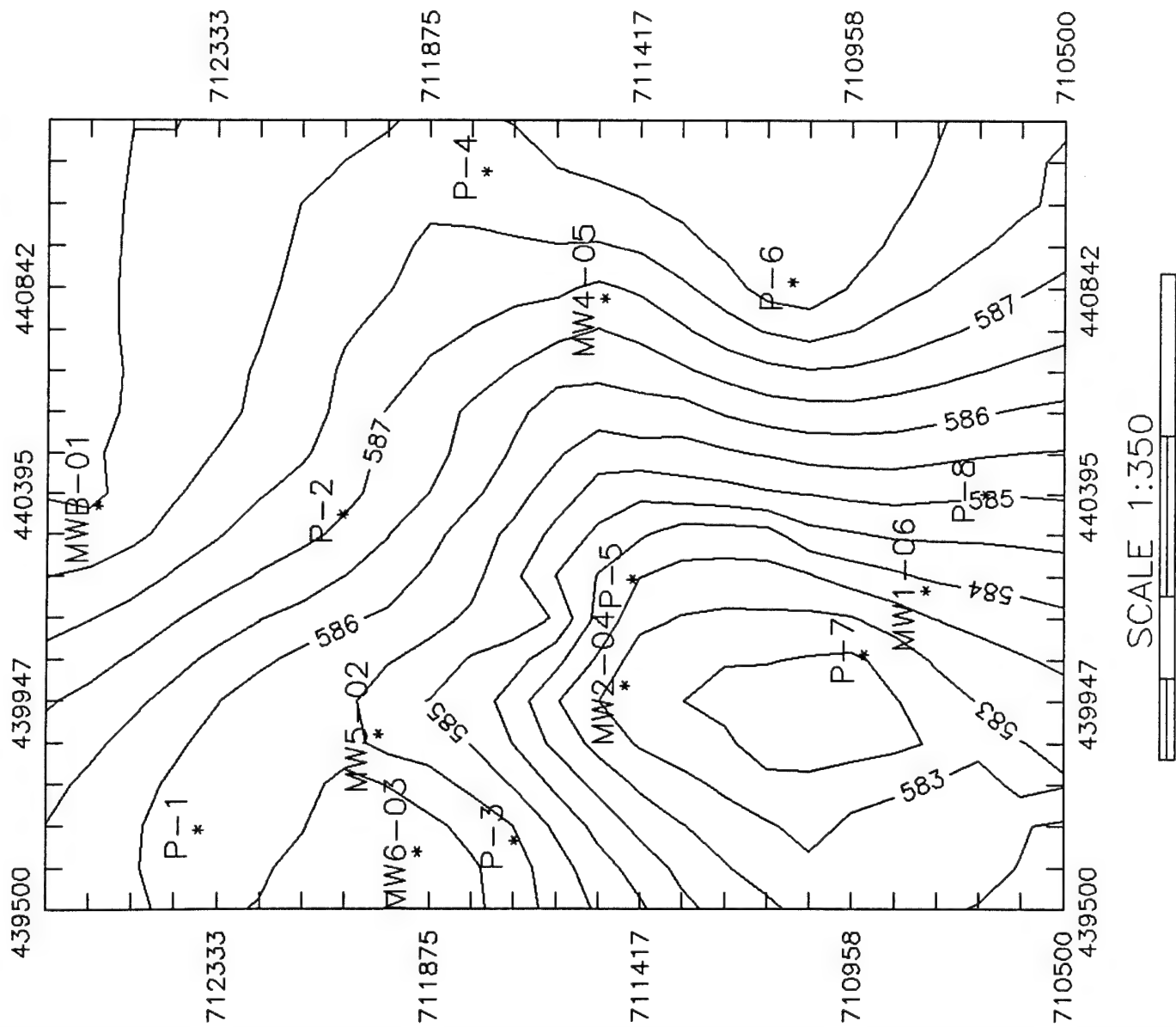
# HULMAN: TOPOGRAPHIC MAP OF THE TILL SURFACE

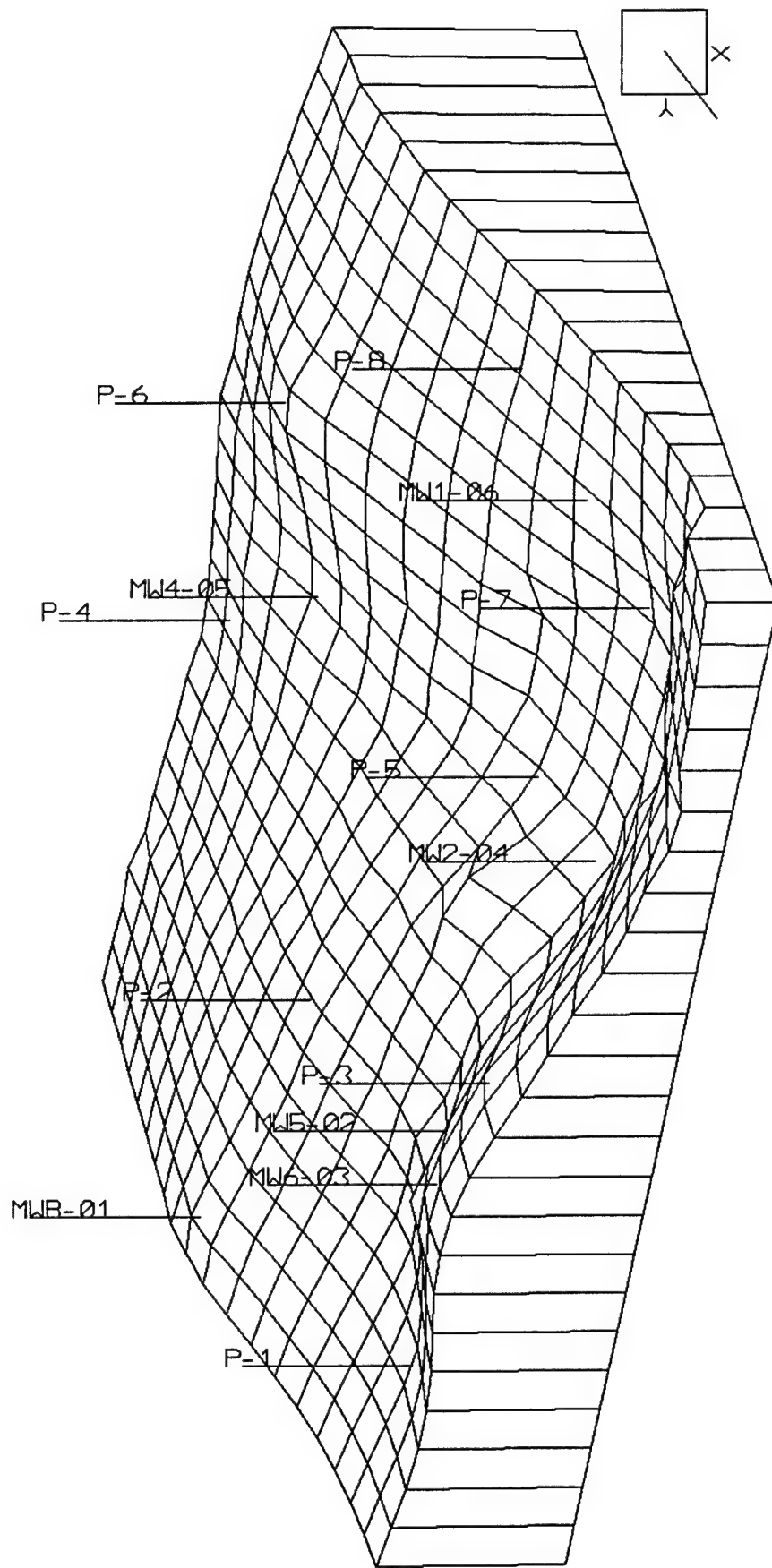




HULMAN TILL SURFACE

# HULMAN GROUND SURFACE TOPOGRAPHIC MAP





HULMAN 3-DIMENSIONAL VIEW OF GROUND SURFACE

**APPENDIX F**  
**Quality Control Data & Validation**

## QUALITY CONTROL / QUALITY ASSURANCE

The following is a summary of quality control samples collected at 181st Fighter Group, Indiana Air National Guard, Hulman Municipal Airport, Terre Haute, Indiana during both sampling rounds. Round one sampling took place from October 11, 1990 through November 10, 1990. Round two sampling took place from January 11, 1992 through January 18, 1992.

### Trip Blanks

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, one trip blank was submitted to the laboratory for each batch of volatile organic samples collected per matrix. Although some samples are of the same matrix, different trip blanks were submitted because each is considered to be taken from a unique source. Trip blanks are collected to verify that the samples were not contaminated during transport.

	<u>SAMPLE IDENTIFICATION</u>	<u>SHIPMENT DATE</u>
ROUND ONE:	BH0 - 01 - T1 - 31	10-11-90
	SS0 - 01 - T1 - 56	10-11-90
	BH0 - 02 - T2 - 32 - 0 - 0	10-12-90
	SS0 - 02 - T2 - 57	10-12-90
	BH0 - 03 - T3 - 33 - 0 - 0	10-13-90
	BH0 - 05 - T5 - 35 - 0 - 0	10-15-90
	BH0 - 04 - T4 - 34 - 0 - 0	10-15-90
	MW0 - 01 - T1 - 79 - 0 - 0	11-09-90
	SE0 - 01 - T1 - 98 - 0 - 0	11-10-90
	MW0 - 02 - T2 - 80 - 0 - 0	11-11-90
	MW0 - 03 - T3 - 90 - 0 - 0	11-11-90
ROUND TWO:	MW0 - 01 - T1 - 117	1-15-92
	MW0 - 02 - T2 - 118	1-16-92
	MW0 - 01 - T3 - 119	1-17-92
	MW0 - 01 - T4 - 120	1-18-92

### Field Blanks

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, field blanks were collected for each water type used during a specific sampling episode.

The two beginning characters of the sample identification indicate the types of samples being taken at the time. An example: BH0 - 00 designates borehole sampling.

A field blank verifies the integrity of the water used for decontamination of sampling equipment.

	<u>SAMPLE IDENTIFICATION</u>	<u>DATE SAMPLED</u>	<u>WATER TYPE</u>
ROUND ONE:	BH0 - 00 - F1 - 39	10-12-90	TAP WATER
	BH0 - 00 - F2 - 40	10-12-90	DEIONIZED WATER
	BH0 - 00 - F3 - 59	10-12-90	HYDRANT WATER
	MW0 - 01 - FD - 81 - 0 - 0	11-09-90	DEIONIZED WATER
	MW0 - 01 - FT - 82 - 0 - 0	11-09-90	TAP WATER
ROUND TWO:	MW0 - 01 - FD - 140	01-15-92	DEIONIZED WATER
	MW0 - 02 - FT - 141	01-15-92	TAP WATER

### Equipment Blanks

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, equipment blanks were collected one per every other day of sampling.

Equipment blanks verify effective decontamination procedures were used in the field.

	DATES SAMPLED	EQUIPMENT BLANKS COLLECTED
ROUND ONE:		
SURFACE SOILS	10-11-90	SSB - 01 - E1 - 58 - 0 - 0
	10-12-90	SS6 - 01 - E1 - 58 - 0 - 0
BORE HOLES	10-12-90	BH5 - 03 - E1 - 36 - 0 - 0
	10-14-90	BH4 - 12 - E2 - 37 - 0 - 0
	10-15-90	BH1 - 15 - E3 - 38 - 0 - 0
SEDIMENTS	11-10-90	SEB - 01 - E1 - 96 - 0 - 0
SURFACE WATERS	11-10-90	SWB - 01 - E1 - 99 - 0 - 0
MONITORING WELLS	11-09-90	MWB - 01 - E1 - 78 - 0 - 0
ROUND TWO:		
MONITORING WELLS	1-16-92	MWB - 01 - E1 - 133 MW1 - 06 - E2 - 134
SURFACE SOILS	1-16-92	SS6 - 16 - E2 - 134

### Field Duplicates

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, field duplicates were collected at a frequency of 1 per 10 samples. Field duplicates determine the variability between duplicate samples.

SAMPLE TYPE	# SAMPLES	DUPLICATE SAMPLE ID
ROUND ONE:		
SURFACE SOILS	17	SS4 - 14 - NS - 54 - 0.0 - 0.5 SS4 - 15 - NS - 55 - 0.0 - 0.5
BORE HOLES	34	BH1 - 15 - NS - 30 - 4.0 - 6.0 BH4 - 11 - NS - 22 - 4.0 - 6.0 BH6 - 04 - NS - 07 - 2.0 - 4.0
SEDIMENTS	5	SE1 - 05 - NS - 95 - 0.0 - 0.0
SURFACE WATERS	3	SW1 - 05 - NS - 87 - 0.0 - 0.0
MONITORING WELLS	7	MW5 - 07 - NS - 76 - 0.0 - 0.0
ROUND TWO:		
SURFACE SOILS	5	SS6 - 21 - 116 - 0.0 - 0.5
MONITORING WELL/ PIEZOMETER	8	MW6 - 07 - NS - 107

### Matrix Spike/Matrix Spike Duplicate

As per the Final Site Investigation Sampling and Analysis Plan, Hulman ANG, September, 1990, matrix spike / matrix spike duplicates were performed one per batch of twenty samples sent to the laboratory for analysis. The field team specified which samples were to be analyzed as matrix spike / matrix spike duplicate due to the need for extra sample volume. MS/MSDs are a recovery check on the actual sampling matrix.

SAMPLE TYPE	QUANTITY	MS/MSD SAMPLE
ROUND ONE:		
SURFACE SOILS	17	SS5 - 05 - NS - 45 - 0 - 0.5
BORE HOLES	34	BH1 - 14 - NS - 27 - 2 - 4 BH2 - 09 - NS - 17 - 2 - 4
SEDIMENTS	5	SE1 - 04 - NS - 94 - 0 - 0
SURFACE WATERS	3	SW1 - 04 - NS - 86 - 0 - 0
MONITORING WELLS	7	MW6 - 03 - NS - 72 - 0 - 0
ROUND TWO:		
SURFACE SOILS	5	SS6- 20- 115- NS - 0 -.5
MONITORING WELL/ PIEZOMETER	8	MW6 - 03 - NS - 103



DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 1. November, 1990 )  
HULMAN ANG

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	BH0-01 T1 - 31 9010L110-003	BH0-02 T2 - 32 0-0 9010L151-002	BH0-04 T4 - 34 0-0 9010L166-022	BH0-05 T5 - 35 0-0 9010L166-010	BH1-15 E3 - 38 0-0 9010L166-005
<b>VOLATILE ORGANICS</b>									
Acetone	CLP	UG/L	10		35	6 UJ	10 U	10 U	10 U
Carbon Disulfide	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Chloroform	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Bromodichloromethane	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Bromoform	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Toluene	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
<b>METALS</b>									
Calcium, Soluble	SW6010	UG/L	500						200 U
Calcium, Total	SW6010	UG/L	500						25 U
Copper, Soluble	SW6010	UG/L	25						40 U
Copper, Total	SW6010	UG/L	25						200 U
Iron, Total	SW6010	UG/L	100						900 U
Magnesium, Soluble	SW6010	UG/L	5000						
Magnesium, Total	SW6010	UG/L	5000						
Sodium, Soluble	SW6010	UG/L	5000						
Sodium, Total	SW6010	UG/L	5000						

DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 1. November, 1990 )  
HULMAN ANG

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	BH4-12 E2 - 37 0-0 9010L185-021	BH5-03 E1 - 36 0-0 9010L151-001	BHO-00 F1 - 39 9010L151-017	BHO-00 F2 - 40 9010L151-018	BHO-00 F3 - 59 9010L151-019
<b>VOLATILE ORGANICS</b>									
Acetone	CLP	UG/L	10		16	30 UJ	23 UJ	22 UJ	20 UJ
Carbon Disulfide	CLP	UG/L	5		10	5 U	5 U	5 U	5 U
Chloroform	CLP	UG/L	5		5 U	1 J	45	7	48
Bromodichloromethane	CLP	UG/L	5		5 U	5 U	38	5 U	37
Dibromochloromethane	CLP	UG/L	5		5 U	5 U	30	5 U	29
Bromoform	CLP	UG/L	5		5 U	5 U	7	5 U	7
Toluene	CLP	UG/L	5		5 U	5 U	1 J	5 U	1 J
<b>METALS</b>									
Calcium, Soluble	SW6010	UG/L	500						
Calcium, Total	SW6010	UG/L	500		200 U	200 U	70800 J	200 U	70100 J
Copper, Soluble	SW6010	UG/L	25		25 U	25 U	25 U	25 U	25 U
Copper, Total	SW6010	UG/L	25		40 U	40 U	50.4	40 U	335
Iron, Total	SW6010	UG/L	100						
Magnesium, Soluble	SW6010	UG/L	5000		200 U	200 U	21700 J	200 U	21600 J
Magnesium, Total	SW6010	UG/L	5000						
Sodium, Soluble	SW6010	UG/L	5000						
Sodium, Total	SW6010	UG/L	5000		900 U	900 U	66300 J	900 U	65700 J

DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 1. November, 1990 )  
HULMAN ANG

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	BHO-03 T3 - 33 0-0 9010L152-005	MW0-01 FD - 81 0.0-0.0 9011L572-008	MW0-01 FD - 81 0.0-0.0 9011L572-001	MW0-01 T1 - 79 0.0-0.0 9011L572-003	MW0-02 FT - 82 0.0-0.0 9011L572-002
<b>VOLATILE ORGANICS</b>									
Acetone	CLP	UG/L	10		10 U		12 UJ	13 UJ	15 UJ
Carbon Disulfide	CLP	UG/L	5		5 U		5 U	5 U	5 U
Chloroform	CLP	UG/L	5		5 U		10	1 UJ	51
Bromodichloromethane	CLP	UG/L	5		5 U		5 U	5 U	29
Dibromochloromethane	CLP	UG/L	5		5 U		5 U	5 U	15
Bromoform	CLP	UG/L	5		5 U		5 U	5 U	2 J
Toluene	CLP	UG/L	5		5 U		2 J	5 U	1 J
<b>METALS</b>									
Calcium, Soluble	SW6010	UG/L	500			5000 U			
Calcium, Total	SW6010	UG/L	500				5000 U		85700
Copper, Soluble	SW6010	UG/L	25			25 U			
Copper, Total	SW6010	UG/L	25				25 U		38.4
Iron, Total	SW6010	UG/L	100				100 U		100 U
Magnesium, Soluble	SW6010	UG/L	5000			5000 U			
Magnesium, Total	SW6010	UG/L	5000				5000 U		25300
Sodium, Soluble	SW6010	UG/L	5000			5000 U			
Sodium, Total	SW6010	UG/L	5000				5000 U		65700

DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 1. November, 1990 )  
HULMAN ANG

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	MW0-02 FT - 82 0.0-0.0 9011L572-009	MW0-02 T2 - 80 0.0-0.0 9011L600-006	MW0-03 T3 - 90 0.0-0.0 9011L600-008	MWB-01 E1 - 78 0.0-0.0 9011L572-010	MWB-01 E1 - 78 0.0-0.0 9011L572-005
<b>VOLATILE ORGANICS</b>									
Acetone	CLP	UG/L	10			2 UJ	4 UJ		12 UJ
Carbon Disulfide	CLP	UG/L	5			5 U	5 U		5 U
Chloroform	CLP	UG/L	5			5 U	5 U		2 UJ
Bromodichloromethane	CLP	UG/L	5			5 U	5 U		5 U
Dibromochloromethane	CLP	UG/L	5			5 U	5 U		5 U
Bromoform	CLP	UG/L	5			5 U	5 U		5 U
Toluene	CLP	UG/L	5			5 U	5 U		5 U
<b>METALS</b>									
Calcium, Soluble	SW6010	UG/L	500		81300			5000 U	5000 U
Calcium, Total	SW6010	UG/L	500						
Copper, Soluble	SW6010	UG/L	25		28.8			25 U	25 U
Copper, Total	SW6010	UG/L	25						100 U
Iron, Total	SW6010	UG/L	100						
Magnesium, Soluble	SW6010	UG/L	5000		24100			5000 U	5000 U
Magnesium, Total	SW6010	UG/L	5000						
Sodium, Soluble	SW6010	UG/L	5000		63900			5000 U	5000 U
Sodium, Total	SW6010	UG/L	5000						

**DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES**  
( Round 1. November, 1990 )  
**HULMAN ANG**

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U-ID Depth, FT LAB ID #	SEB-01 E1-96 0.0-0.0 9011L576-004	SEO-01 T1-98 0.0-0.0 9011L576-003	SS0-01 T1- 56 9010L110-008	SSB-01 E1-58 0-0 9010L151-003	SSB-01 E1-58 0-0 9010L110-007
<b>VOLATILE ORGANICS</b>									
Acetone	CLP	UG/L	10		12 UJ	4 UJ	8 J	37 UJ	10 UJ
Carbon Disulfide	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Chloroform	CLP	UG/L	5		1 J	5 U	5 U	1 J	5 U
Bromodichloromethane	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Dibromochloromethane	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Bromoform	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
Toluene	CLP	UG/L	5		5 U	5 U	5 U	5 U	5 U
<b>METALS</b>									
Calcium, Soluble	SW6010	UG/L	500						
Calcium, Total	SW6010	UG/L	500		5000 U			200 U	200 U
Copper, Soluble	SW6010	UG/L	25						
Copper, Total	SW6010	UG/L	25		25 U			25 U	25 U
Iron, Total	SW6010	UG/L	100		100 U			40 U	40 U
Magnesium, Soluble	SW6010	UG/L	5000						
Magnesium, Total	SW6010	UG/L	5000		5000 U			200 U	200 U
Sodium, Soluble	SW6010	UG/L	5000						
Sodium, Total	SW6010	UG/L	5000		5000 U			900 U	900 U

DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 1. November, 1990 )  
HULMAN ANG

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	SSO-02 T2 - 57 9010L161-018	SWB-01 E1 - 90 0.0-0.0 9011L576-013	SWB-01 E1 - 90 0.0-0.0 9011L576-005
<b>VOLATILE ORGANICS</b>							
Acetone	CLP	UG/L	10		15 UJ		8 UJ
Carbon Disulfide	CLP	UG/L	5		5 U		5 U
Chloroform	CLP	UG/L	5		5 U		1 J
Bromodichloromethane	CLP	UG/L	5		5 U		5 U
Dibromochloromethane	CLP	UG/L	5		5 U		5 U
Bromoform	CLP	UG/L	5		5 U		5 U
Toluene	CLP	UG/L	5		5 U		5 U
<b>METALS</b>							
Calcium, Soluble	SW6010	UG/L	500			5000 U	
Calcium, Total	SW6010	UG/L	500				5000 U
Copper, Soluble	SW6010	UG/L	25			25 U	
Copper, Total	SW6010	UG/L	25				25 U
Iron, Total	SW6010	UG/L	100				100 U
Magnesium, Soluble	SW6010	UG/L	5000			5000 U	
Magnesium, Total	SW6010	UG/L	5000				5000 U
Sodium, Soluble	SW6010	UG/L	5000			5000 U	
Sodium, Total	SW6010	UG/L	5000				5000 U

**DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 2. January, 1992 )  
HULMAN ANG**

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	MW0-01 FD - 140R 9201L056-010	MW0-01 FD - 140R 9201L056-014	MW0-01 T1 - 117 9201L030-003	MW0-02 FT - 141 9201L030-001
<b>VOLATILE ORGANICS</b>								
1,1,1-Trichloroethane	CLP	UG/L	10				10 U	10 U
Bromodichloromethane	CLP	UG/L	10				10 U	17
Dibromochloromethane	CLP	UG/L	10				10 U	12
Bromoform	CLP	UG/L	10	6 J 10 U 10 U 10 U			10 U	3 J
<b>METALS</b>								
Calcium, Total	SW6010	UG/L	5000		5000 U			
Copper, Total	SW6010	UG/L	25		25 U			
Sodium, Total	SW6010	UG/L	5000		5000 U			
Calcium, Soluble	SW6010	UG/L	5000			5000 U		
Copper, Soluble	SW6010	UG/L	25			25 U		
Sodium, Soluble	SW6010	UG/L	5000			5000 U		

DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 2. January, 1992 )  
HULMAN ANG

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	MW0-02 FT - 141R 9201L056-015	MW0-02 FT - 141R 9201L056-011	MW0-02 T2 - 118 9201L056-005	MW0-03 T3 - 118 9201L068-003	MW0-04 T4 - 120 9201L073-003
<b>VOLATILE ORGANICS</b>									
1,1,1-Trichloroethane	CLP	UG/L	10	10			10 U	10 U	10 U
Bromodichloromethane	CLP	UG/L	10	10			10 U	10 U	10 U
Dibromochloromethane	CLP	UG/L	10	10			10 U	10 U	10 U
Bromoform	CLP	UG/L	10	10			10 U	10 U	10 U
<b>METALS</b>									
Calcium, Total	SW8010	UG/L	5000	5000		10800			
Copper, Total	SW8010	UG/L	25	25		35			
Sodium, Total	SW8010	UG/L	5000	5000		178000			
Calcium, Soluble	SW8010	UG/L	5000	5000	10700				
Copper, Soluble	SW8010	UG/L	25	25	33.2				
Sodium, Soluble	SW8010	UG/L	5000	5000	175000				



**DETECTED CONCENTRATIONS FOR  
QUALITY ASSURANCE SAMPLES  
( Round 2. January, 1992 )  
HULMAN ANG**

PARAMETER	METHOD	UNITS	REPTD DETECT LIMIT	LOCATION U - ID Depth, FT LAB ID #	MW1-08 E2 - 134 9201L056-013	MW1-08 E2 - 134 9201L056-017	MWB-01 E1 - 133 9201L056-012	MWB-01 E1 - 133 9201L056-016	SS8-16 E2 - 134 9201L056-001
<b>VOLATILE ORGANICS</b>									
1,1,1-Trichloroethane	CLP	UG/L	10		10 U		10 U		10 U
Bromodichloromethane	CLP	UG/L	10		10 U		10 U		10 U
Dibromochloromethane	CLP	UG/L	10		10 U		10 U		10 U
Bromoform	CLP	UG/L	10		10 U		10 U		10 U
<b>METALS</b>									
Calcium, Total	SW6010	UG/L	5000		5000 U		5000 U		5000 U
Copper, Total	SW6010	UG/L	25		25 U		25 U		25 U
Sodium, Total	SW6010	UG/L	5000		5000 U		5000 U		5000 U
Calcium, Soluble	SW6010	UG/L	5000			5000 U		5000 U	
Copper, Soluble	SW6010	UG/L	25			25 U		25 U	
Sodium, Soluble	SW6010	UG/L	5000			5000 U		5000 U	

## DATA VALIDATION AND DATA QUALITY SUMMARY

Samples collected at the 181st TFG were submitted for analysis at a HAZWRAP-approved laboratory, Weston Analytical of Lionville, PA. Soil, sediment, groundwater and surface water samples were analyzed for target compound list (TCL) volatile organics, TCL semivolatile organics, and total petroleum hydrocarbons (TPH). Samples from all sites except Sites 2 and 4 were also analyzed for target analyte list (TAL) metals and pesticides/PCBs.

The intention of the sampling and analysis effort was to produce data of acceptable quality which would allow for an accurate evaluation of the vertical and horizontal distribution of contamination at the site. The main quality assurance (QA) objectives for this work is that all measurements be precise, accurate and representative of the actual site conditions and that all data resulting from sampling and analysis be comparable and complete. These objectives were met by performing certain field and laboratory quality control (QC) activities.

To ensure that the data quality objectives were met, M&E evaluated the sample and QC analytical data as stated in the QAPP using HAZWRAP Level C data validation guidelines, as outlined in the HAZWRAP/DOE documents:

"Requirements for Quality Control of Analytical Data", August 1988

"Requirements for Quality Control of Analytical Data", July 1990

The first round of samples, collected in October and November 1990, were analyzed according to criteria set forth in the "CLP SOW 2/88" and were validated using the HAZWRAP, August 1988 validation guidelines, while the second round of samples, collected in January 1992 were analyzed according to criteria set forth in the "CLP SOW 3/90" and were validated using the HAZWRAP, July 1990 validation guidelines.

The following pages present a discussion of the QA/QC summary results.

### DATA QUALITY SUMMARY

The overall quality of the data is summarized in terms of the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. This discussion is based on the data validation results summaries which are attached.

#### Precision

Precision is a measure of agreement among individual measurements of the same property under similar conditions. It is expressed in

terms of relative percent difference (RPD) between replicates. Precision was determined through the collection and analysis of field duplicates for all matrices, namely surface soils, subsurface soils, sediments, surface water, and groundwater. Precision for these matrices was also evaluated through the use of matrix spike and matrix spike duplicate analyses.

### **Accuracy**

Accuracy is defined as the degree of agreement of a measurement (or measurement average) with an accepted reference or true value. It is a measure of system bias and is usually expressed as a percentage of the true value. Accuracy was assessed through the results of initial and continuing calibration checks, surrogate recoveries and the recoveries of spiked compounds for MS/MSD samples, in addition to the analysis of lab blanks, trip blanks, equipment blanks and field duplicates.

**Accuracy of VOC Analyses.** The accuracy of VOC analyses was affected due to QC issues relating to blank contamination and calibration problems. Blank contamination with methylene chloride, acetone, carbon disulfide, and chloroform was apparent in laboratory method blanks and trip and equipment blanks associated with both the water and the soil samples. Analysis of source water used for decontamination of field equipment resulted in the detection of low levels of acetone, methylene chloride and carbon disulfide.

**Accuracy of SVOC Analyses.** Blank contamination was apparent in both laboratory method blanks and field equipment blanks, and affected the detection di-n-butylphthalate, bis(2-ethylhexyl)phthalate in field samples, both soil and water. The data from a few samples, containing high concentrations of these were accepted as positive detections, however, the majority of these were qualified as not detectable above the blank contaminant action level concentration.

Surrogate recoveries met criteria for the most part, however, poor surrogate recoveries were apparent in a few of the analyses. The lab usually reanalyzed the samples for those that were way out of criteria. Low surrogate recoveries resulted in the estimation of both detected and non-detected compound quantification.

Other quality control problems include exceeding holding time criteria (for the Round 2 soils which had to be reanalyzed for reasons stated in the validation summaries), and calibration problems.

**Accuracy of Pesticide/PCB Analyses.** Minor problems were evident from the validation of the Pesticide/PCB data, the most significant of which resulted in the flagging of results for three samples due to exceedance of holding times. Some soil data was also flagged due to high MS/MSD and BS/BSD recoveries for a few compounds.

**Accuracy of Metals Analyses.** Validation criteria relating to the accuracy of metals analyses were met except for blanks and MS/MSDs. Blank contamination, mainly zinc, was apparent in laboratory blanks and field blanks (i.e. equipment and source water blanks). Matrix spike recoveries were often outside of criteria for a number of compounds including, but not limited to antimony, arsenic, selenium, thallium, magnesium, sodium, and potassium. The data was qualified accordingly.

**Accuracy of TPH Analyses.** The only criteria which was not met 100% for the TPH analyses was the blank analysis for two batches of samples. Contamination of the equipment blank was apparent for those two cases.

### **Representativeness**

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a data population, a sampling point or an environment. For this site investigation, grab samples were taken, and such samples are strictly representative only of the conditions at the location and time collected, within sampling and analytical error. Samples were handled and preserved properly and most of the analyses were performed within holding times the data, so that it is expected that the data is fairly representative of conditions in the area sampled.

### **Comparability**

Comparability expresses the confidence with which one data set can be compared to another. Sampling and analysis procedures consistent with HAZWRAP and EPA CLP protocols were used for each specific site and in both sampling rounds so that all data sets are comparable within a specific site and between sites at the 181st TFG. As stated earlier, the samples from Round 2 were analyzed using the "3/90 SOW" which was not yet in use during the earlier sampling round, however, this does not affect the comparability of the data. Data are reported in consistent units of ug/l, mg/l, and ug/kg.

## **Completeness**

Completeness is a measure of the amount of valid data obtained after analysis compared to the amount of samples collected. It is usually expressed as a percentage. All samples collected arrived at the laboratory intact and were analyzed to produce valid data. Data validation resulted in the rejection of only a minor amount of the data, mainly for non-detects of arsenic, lead and mercury in some Site 1 and Site 6 soils due to low MS/MSD recoveries. The VOA fraction for one Site 6 borehole soil was also rejected because the surrogates were diluted out. The non-detect results for 2-butanone which were rejected for the Round 2 samples did not meet the HAZWRAP validation calibration criteria, but they do meet the new "3/90 SOW analytical criteria."

Completeness was greater than 95% for the combined sampling rounds.

**DATA VALIDATION RESULTS**

# **DATA SUMMARY KEY**

- A - Acceptable Data.
- J - The associated numerical value is an estimated quantity.
- R - Reject data due to quality control criteria. The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.
- U - The compound was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
- UJ - The compound was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

## HULMAN DATA VALIDATION RESULTS SUMMARY

### Case No. RFW9010L110

9 Soils: BHB-01-NS-01-2.0-4.0, BHB-01-NS-02-4.0-6.0,  
SS5-03-NS-43-0.0-0.5, SS5-04-NS-44-0.0-0.5,  
SS5-05-NS-45-0.0-0.5, SSB-01-NS-41-0.0-0.5,  
SSB-02-NS-42-0.0-0.5, SS2-08-NS-48-0.0-0.5,  
SS2-09-NS-49-0.0-0.5

3 Aqueous: SSB-01-E1-58-0-0, SS0-01-T1-56, BH0-01-T1-31

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L110 low level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . GC/MS Tuning
- \* . calibration
- . blanks
- . blank/spike control samples
- \* . blank/spike laboratory control samples
- . surrogate recoveries
- . matrix spike/matrix spike duplicate
- . pesticide instrument (GC) performance

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### ORGANICS

#### Blanks:

The semivolatile, pesticide/PCB and TPH blanks contained no contaminants. The volatile lab, equipment and trip blanks are summarized below:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	17 ug/kg	170 ug/kg (ug/l)
Acetone	35 ug/kg	350 ug/kg (ug/l)
Chloroform	1 ug/kg	5 ug/kg



**Blank Actions:**

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

**Blank/Spike Control Sample (BS/BSD):**

The VOA and pesticide/PCB BS/BSD samples met QC criteria. Recovery of 2,4-dinitrotoluene (99%) was high for the aqueous SVOA blank/spike control sample. No action was necessary however, since the compound was not detected in the samples.

**Matrix Spike / Matrix Spike Duplicate:**

Soil matrix spike recoveries were high for the semivolatile and pesticide / PCB analyses. The semivolatile compounds which were affected are phenol (102), n-nitroso-di-n-propylamine (133), 4-chloro-3-methylphenol (118), 4-nitrophenol, 2,4-dinitrotoluene (105) and pentachlorophenol (114). The affected pesticide / PCB compounds include lindane (305), heptachlor (305), aldrin (283), dieldrin (312), endrin (360), and 4,4'-DDT (380). All positive results for these compounds were flagged as estimated (J) and non-detects were accepted since no recoveries were below 10%.

**Surrogate Recoveries:**

Surrogate recoveries were within the QC limits for the VOA and SVOA fractions. The pesticide / PCB fraction showed interference with the recovery of dibutylchloroendate. Sample results were therefore qualified as estimated, UJ for non-detects and J for positive results.

**Pesticide Instrument (GC) Performance:**

Retention time windows were outside of criteria for endosulfan II and methoxychlor in one Ind-C standard. Initial calibration was out for aldrin on the quantitation column, and the continuing calibration for alpha-BHC was out for sample SSB-01-NS-41-0.0-0.5. No sample results were affected, therefore no action was necessary.

## INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

### Blanks:

Beryllium contamination was found in the soil blank and, as a result, all beryllium hits in the soil samples were flagged as estimated (UJ) since they were all below the action level of 2.4 mg/kg.

### Matrix Spike / Matrix Spike Duplicate:

Soil matrix spike recoveries were low for silver, arsenic, lead, antimony, and selenium. Results for these analytes were flagged as estimated; J for positive values and UJ for non-detects. There were no non-detects for lead, else these would have been rejected (R) since MS recovery for lead was below 30%.

Recoveries for aluminum, calcium, iron, magnesium, sodium, potassium, and thallium were higher than the upper limit of 125%. All non-detects hits for these analytes were estimated (J) for all soil samples.

The water matrix spike recoveries were high for calcium, potassium, magnesium, and sodium, however data is not affected since there were no detects.

**Note:** The calibration criteria (90-100% for ICP and AA metals and 85-115% for Hg) which the lab reported in their case narrative is different from that (90-110% for ICP/AA and 80-120% for Hg) stated in the QAPP and on Form 2A. This does not affect the data however.

Hulman Field  
RFW # 9010L110

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
BHB-01-NS-01-2.0-4.0	A <sup>3</sup>	A	A	A <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup>	A
BHB-01-NS-02-4.0-6.0	A <sup>3</sup>	A	J <sup>4</sup>	A <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup>	A
SS5-03-NS-43-0.0-0.5	A <sup>2</sup>	A	A	A <sup>4</sup> , J <sup>5</sup>	A
SS5-04-NS-44-0.0-0.5	A <sup>2</sup>	A	J <sup>4</sup>	A <sup>4</sup> , J <sup>5</sup>	A
SS5-05-NS-45-0.0-0.5	A <sup>2</sup>	J <sup>1</sup>	J <sup>3</sup> , J <sup>4</sup>	A <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup>	A
SS2-08-NS-48-0.0-0.5	A <sup>2</sup>	A	--	--	A
SS2-09-NS-49-0.0-0.5	A <sup>2</sup>	A	--	--	A
SSB-02-NS-42-0.0-0.5	A <sup>2</sup>	A	A	A <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup>	A
SSB-01-NS-41-0.0-0.5	A <sup>2</sup>	A	J <sup>4</sup>	A <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup>	A
SSB-01-E1-58-0-0	A <sup>2</sup>	J <sup>2</sup>	A	A	A
SS0-01-T1-56	A <sup>1</sup>	--	--	--	--
BH0-01-T1-31	A <sup>1</sup>	--	--	--	--

A - Accept all data.

A<sup>1</sup> - Accept data but flag as non-detect (UJ) all positive values for methylene chloride less than the action level due to blank contamination.

A<sup>2</sup> - Accept data but flag as non-detect (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.

A<sup>3</sup> - Accept data but flag as non-detect (UJ) all positive values for methylene chloride, acetone, and chloroform less than the action level due to blank contamination.

A<sup>4</sup> - Accept data but flag as non-detect (UJ) all positive results for beryllium less than 2.4 mg/kg due to blank contamination.

J<sup>1</sup> - Qualify as estimated (J) all positive results for n-nitroso-di-n-propylamine, 4-chloro-3-methylphenol, 4-nitrophenol, 2,4-dinitrotoluene and pentachlorophenol due to high matrix spike recoveries.

J<sub>2</sub> - Estimate (J) positive values for 2,4-dinitrotoluene and 1,4-dichlorobenzene due to high blank spike recovery.

J<sup>3</sup> - Qualify as estimated (J) positive results for lindane, aldrin, heptachlor, dieldrin, endrin, and 4,4'-DDT due to high matrix spike recoveries.

J<sup>4</sup> - Qualify as estimated (J) all positive results and (UJ) all non-detects for all compounds due to interference with the recovery of the surrogate compound dibutylchloroendate.

J<sup>5</sup> - Qualify as estimated (J) all positive results and (UJ) all non-detects for silver, arsenic, antimony, lead, and selenium due to low matrix spike recoveries.

J<sup>6</sup> - Estimate (J) positive values for calcium, magnesium, sodium, potassium, and thallium due to high matrix spike recoveries.

-- - The sample was not analyzed for these parameters.

## HULMAN DATA VALIDATION RESULTS SUMMARY

### Case No. RFW9010L151

12 Soils: BH5-02-NS-03-3.0-5.0, BH5-02-NS-04-5.0-7.0,  
BH5-03-NS-05-1.0-3.0, BH5-03-NS-06-5.0-7.0,  
SS1-12-NS-52-0.0-0.5, SS1-13-NS-53-0.0-0.5,  
SS4-10-NS-50-0.0-0.5, SS4-11-NS-51-0.0-0.5,  
SS4-15-NS-55-0.0-0.5, SS6-06-NS-46-0.0-0.5,  
SS6-07-NS-47-0.0-0.5, SS6-14-NS-54-0.0-0.5,  
  
7 Aqueous: BH5-03-E1-36-0-0, BH5-02-T2-32-0-0, SS6-01-E1-58-0-0,  
SS0-02-T2-57, BH0-00-F1-39, BH0-00-F2-40, BH0-00-F3-59

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L151 low and medium level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . GC/MS Tuning
- . calibration
- . blanks
- . blank/spike control samples
- \* . blank/spike laboratory control samples
- \* . surrogate recoveries
- . matrix spike/matrix spike duplicate
- . pesticide instrument (GC) performance

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### ORGANICS

#### Calibration:

The VOA, SVOA, and TPH calibrations all met QC criteria. The %RSDs for the pesticide initial and continuing calibrations exceeded the 10% criteria, however no action was necessary since there were no positive results.

#### Blanks:

The semivolatile, pesticide/PCB and TPH blanks contained no contaminants. The volatile lab, equipment and trip blanks are summarized below:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	8 ug/kg	80 ug/kg (ug/L)
Acetone	20 ug/kg	200 ug/kg (ug/L)
Chloroform	1 ug/kg	5 ug/kg
Carbon Disulfide	1 ug/L	5 ug/L
Med. Level:		
Methylene Chloride	1700 ug/kg	17000 ug/kg
Acetone	1800 ug/kg	18000 ug/kg
Chloroform	125 ug/kg	625 ug/kg

**Blank Actions:**

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

**Blank/Spike Control Sample (BS/BSD):**

The VOA BS/BSD sample met QC criteria. The SVOA fraction showed low recovery of pentachlorophenol, while the pesticide/PCB fraction had high recoveries for dieldrin, endrin and 4,4'-DDT as follows:

<u>Compound</u>	<u>% Recovery</u>	<u>QC Limits</u>
Pentachlorophenol	13	17 - 109
Dieldrin	160	31 - 134
Endrin	151	42 - 139
4,4'-DDT	187	23 - 134

Positive results for these compounds will be flagged as estimated (J) and non-detects will be accepted since no recoveries were below 10%.

**Surrogate Recoveries:**

One surrogate standard for the acid fraction of the SVOAs had a recovery greater than the required specification. No qualifying actions were necessary however.

**Pesticide Instrument (GC) Performance:**

Retention time windows were outside of criteria for endosulfan II and methoxychlor in the Ind-A standard. This Ind-A was the last one in the 72-hr sequence and did not affect any data.

**INORGANICS**

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

**Blanks:**

Zinc contamination was found in the aqueous method blank and, as a result, all positive zinc results for the water samples were flagged as estimated (UJ) since they were all below the action level of 180 ug/l.

**Matrix Spike / Matrix Spike Duplicate:**

Soil matrix spike recoveries were low for antimony, copper, manganese, selenium, and thallium; therefore results for these were flagged as estimated (J for positive values and UJ for non-detects). Recoveries for potassium, magnesium, and sodium were high (>125%), so hits for these analytes were flagged as estimated (J) for all soil samples.

Water matrix spike recoveries were also high for calcium, potassium, magnesium, and sodium, so hits for these analytes were flagged as estimated (J) for all water samples.

**Note:** The calibration criteria (90-100% for ICP and AA metals and 85-115% for Hg) which the lab reported in their case narrative is different from that (90-110% for ICP/AA and 80-120% for Hg) stated in the QAPP and on Form 2A. This does not affect the data however.

Hulman Field  
RFW # 9010L151

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
BH5-02-NS-03-3.0-5.0	A <sup>1</sup>	J <sup>1</sup>	--	J <sup>4</sup>	A
BH5-02-NS-04-5.0-7.0	A <sup>1</sup>	J <sup>1</sup>	--	J <sup>4</sup>	A
BH5-03-NS-05-1.0-3.0	A <sup>1</sup>	J <sup>1</sup>	--	J <sup>4</sup>	A
BH5-03-NS-06-5.0-7.0	A <sup>1</sup>	J <sup>1</sup>	--	J <sup>4</sup>	A
SS1-12-NS-52-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	J <sup>2</sup>	J <sup>4</sup>	A
SS1-13-NS-53-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	J <sup>2</sup>	J <sup>4</sup>	A
SS4-10-NS-50-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	--	--	A
SS4-11-NS-51-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	--	--	A
SS4-15-NS-55-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	--	--	A
SS6-06-NS-46-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup>	A
SS6-07-NS-47-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup>	A
SS6-14-NS-54-0.0-0.5	A <sup>1</sup>	J <sup>1</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup>	A
BH5-03-E1-36-0-0	A <sup>2</sup>	A	A	A	A
BH5-02-T2-32-0-0	A <sup>2</sup>	--	--	--	--
SS6-01-E1-58-0-0	A <sup>2</sup>	A	A	A	A
SS0-02-T2-57	A <sup>2</sup>	--	--	--	--
BH0-00-F1-39	A <sup>2</sup>	A	A	A <sup>3</sup> , J <sup>3</sup>	A
BH0-00-F2-40	A <sup>2</sup>	A	A	A <sup>3</sup>	A
BH0-00-F3-59	A <sup>2</sup>	A	A	J <sup>3</sup>	A

A - Accept all data.

A<sup>1</sup> - Accept data but estimate (UJ) all positive values for acetone, methylene chloride and chloroform greater than the CRQL but less than the action level due to blank contamination.

A<sup>2</sup> - Accept data but estimate (UJ) all positive values for acetone, methylene chloride and carbon disulfide greater than the CRQL but less than the action level due to blank contamination.

A<sup>3</sup> - Accept data but estimate (UJ) all positive values for zinc less than 180 ug/l due to blank contamination.

J<sup>1</sup> - Estimate (J) all positive results for pentachlorophenol due to low blank spike recovery.

J<sup>2</sup> - Estimate (J) all positive results for dieldrin, endrin, and 4,4'-DDT due to high blank spike recovery.

J<sup>3</sup> - Estimate (J) all positive results for calcium, magnesium and sodium due to high water matrix spike recovery.

J<sup>4</sup> - Estimate (J) all positive results and estimate (UJ) all negative results for antimony, copper, selenium, and thallium due to low soil matrix spike recoveries.

J<sup>5</sup> - Estimate (J) all positive results for magnesium, sodium and potassium due to high soil matrix spike recoveries.

-- - The sample was not analyzed for this parameter.

## HULMAN DATA VALIDATION RESULTS SUMMARY

### Case No. RFW9010L152

6 Soils: BH2-07-NS-13-2.0-4.0, BH2-07-NS-14-4.0-6.0,  
BH2-08-NS-15-0.0-2.0, BH2-08-NS-16-4.0-6.0,  
BH2-09-NS-17-2.0-4.0, BH2-09-NS-18-4.0-6.0,

1 Aqueous: BH0-03-T3-33-0-0

A validation was performed on the organic analytical data from Case No. RFW#9010L152 low and medium level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . GC/MS Tuning
- \* . calibration
- . blanks
- \* . blank/spike control samples
- \* . surrogate recoveries
- . matrix spike/matrix spike duplicate

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### Blanks:

The semivolatile and TPH blanks contained no contaminants. The volatile laboratory, trip and equipment blanks are summarized below:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	17 ug/kg	170 ug/kg
Acetone	31 ug/kg	310 ug/kg
* Carbon Disulfide	10 ug/l	50 ug/kg
Med. Level:		
Methylene Chloride	1700 ug/kg	20000 ug/kg
Acetone	1800 ug/kg	53000 ug/kg
* Carbon Disulfide	10 ug/l	6250 ug/kg



**Blank Actions:**

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified
- \* carbon disulfide was found in the equipment blank only.

The action levels were compared to sample values and the appropriate data qualifications were made.

**Matrix Spike / Matrix Spike Duplicate:**

The volatile percent recoveries were within the specified criteria. For the semivolatile matrix spike, phenol, 2-chlorophenol, 4-chloro-3-methylphenol, and 2,4-dinitrotoluene all had slightly high percent recoveries. No action was necessary however, since there were no positive results.

Hulman Field  
RFW # 9010L152

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	TPH
BH2-07-NS-13-2.0-4.0	A <sup>1</sup>	A	A
BH2-07-NS-14-4.0-6.0	A <sup>1</sup>	A	A
BH2-08-NS-15-0.0-2.0	A <sup>1</sup>	A	A
BH2-08-NS-16-4.0-6.0	A <sup>1</sup>	A	A
BH2-09-NS-17-2.0-4.5	A <sup>1</sup>	A	A
BH2-09-NS-18-4.0-6.5	A <sup>1</sup>	A	A
BH0-03-T3-33-0-0	A <sup>2</sup>	--	--

A - Accept all data.

A<sup>1</sup> - Accept data but flag as non-detect (UJ) all positive values for acetone, methylene chloride and carbon disulfide less than the action level due to blank contamination.

A<sup>2</sup> - Accept data but flag as non-detect (UJ) all positive values for methylene chloride less than 80 ug/l due to blank contamination.

J<sup>1</sup> - Estimate (J) positive results for phenol, 2-chlorophenol, 4-chloro-3-methylphenol, and 2,4-dinitrotoluene due to high matrix spike recoveries.

-- - The sample was not analyzed for this parameter

## HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L166

- 18 Soils: BH6-04-NS-07-2.0-4.0, BH6-04-NS-08-4.0-6.0,  
BH6-05-NS-09-0.0-2.0, BH6-05-NS-10-4.0-6.0,  
BH1-14-NS-27-2.0-4.0, BH1-14-NS-28-4.0-6.0,  
BH1-15-NS-29-2.0-4.0, BH1-15-NS-30-4.0-6.0,  
BH2-06-NS-11-2.0-4.0, BH2-06-NS-12-4.0-6.0,  
BH4-10-NS-19-2.0-4.0, BH4-10-NS-20-4.0-6.0,  
BH4-11-NS-21-2.0-4.0, BH4-11-NS-22-4.0-6.0,  
BH4-12-NS-23-2.0-4.0, BH4-12-NS-24-4.0-6.0,  
BH4-13-NS-25-2.0-4.0, BH4-13-NS-26-4.0-6.0,
- 4 Aqueous: BH1-15-E3-38-0-0, BH4-12-E2-37-0-0,  
BH0-05-T5-35-0-0, BH0-04-T4-34-0-0

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L166 low and medium level soils and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . GC/MS Tuning
- \* . calibration
- . blanks
- . blank/spike control samples
- . blank/spike laboratory control samples
- . surrogate recoveries
- . matrix spike/matrix spike duplicate
- . pesticide instrument (GC) performance

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### ORGANICS

#### Blanks:

The organic blanks are summarized in the following table which shows the maximum contaminant concentration in any of the lab, equipment or trip blanks:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	20 ug/l	200 ug/kg (ug/l)
Acetone	31 ug/kg	310 ug/kg (ug/l)
Carbon Disulfide	10 ug/l	50 ug/kg (ug/l)
Benzoic Acid	60J ug/l	5 ug/l
4-Chloroaniline	360J ug/kg	1800 ug/kg
4,4'-DDD	0.090J ug/l	0.450 ug/l
4,4'-DDE	0.10 ug/l	0.50 ug/l
TPH	4.7 mg/kg	23.5 mg/kg
Med. Level:		
Methylene Chloride	2300 ug/kg	23000 ug/kg
Acetone	1400 ug/kg	14000 ug/kg
Trichloroethene	170J ug/kg	850 ug/kg

#### **Blank Actions:**

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made. No action was taken on the pesticide/PCB fraction since there were no positive results.

#### **Blank/Spike Control Sample (BS/BSD):**

The VOA BS/BSD sample met QC criteria. The aqueous pesticide/PCB fraction showed low recovery of 4,4'-DDT and alpha-BHC, while the soil BS/BSD SVOA and pesticide fractions had high recoveries for phenol and 2,4-dinitrotoluene and for endrin and 4,4'-DDT, respectively.

Positive results for these compounds will be flagged as estimated (J) and non-detects will be accepted since no recoveries were below 10%.

#### **Surrogate Recoveries:**

The surrogates which did not meet criteria are summarized below:

<u>TR#s</u>	<u>VOA</u>			<u>SVOA</u>
	<u>TOL</u>	<u>BFB</u>	<u>DCF</u>	<u>TBP</u>
BH6-05-NS-09-0.0-2.0	Dil	Dil	Dil	
BH4-10-NS-19-4.0-6.0				128

All three surrogate compounds for the VOA fraction were diluted out of sample BH6-05-NS-09-0.0-0.2. All positive VOA results for this sample were qualified as estimated and all non-detects were rejected. No qualifying actions were necessary for the SVOA and pesticide/PCB fractions.

**Matrix Spike/Matrix Spike Duplicates:**

The volatile and semivolatile percent recoveries and relative percent differences were within the specified criteria. There was interference with the recovery of dieldrin, endrin, and 4,4'-DDT in the pesticide/PCB fraction. Positive results for these compounds will therefore be flagged as estimated. No MS/MSD was done on the medium level soil.

**Pesticide Instrument (GC) Performance:**

All 4,4'-DDT retention times were greater than 12 minutes, and a few compounds (in the very last standard) including 4,4'-DDT, methoxychlor, endosulfan II, and endosulfan sulfate were slightly outside of the established retention time windows. These did not affect the data since this was the last standard in the 72-hour sequence.

## INORGANICS

All criteria were met for holding times and calibration.

### Blanks:

Soil blank samples met criteria. One equipment blank and the method blank associated with the water samples contained zinc. As a result, all positive zinc results for the water samples were flagged as estimated (UJ) if the concentration was below the action level of 180 ug/l.

### Blank Spike / Laboratory Control Sample:

The aqueous lab control sample (LCS) was within QC criteria. The solid LCS had a recovery below the lower limit (80%) for silver (66.1%) and above the upper limit (120%) for selenium (122%). No action was necessary for selenium since all samples were non-detects. Results for silver were estimated (UJ) however. They were no positive results for these compounds.

### Matrix Spike / Matrix Spike Duplicate:

Water matrix spike recovery for mercury was high for one sample (E3-38) and low for the other (E2-37). Results for this analyte were flagged as estimated (J for positive values and UJ for non-detects) for the water samples.

Soil matrix spike recoveries were high for aluminum, calcium, iron, potassium, magnesium, manganese, and sodium. Positive results for Ca, K, Mg, and Na were flagged (J) as estimated. No action was necessary for Al, Fe, and Mn since the sample concentrations for these compounds were more than four times the spike concentration. Recoveries for arsenic, mercury, and thallium were below the lower recovery limit (<75%). Positive results for these three analytes were flagged (J) as estimated. Non-detects for Tl were also flagged as estimated (UJ) while, non-detects for arsenic and mercury were rejected (R).

**Note:** Laboratory incorrectly reported MS %recovery for As as 47.5%. A calculation using the result reported in the unspiked sample shows that the recovery was actually 18.7%.

Hulman Field  
RFW # 9010L166

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
BH6-04-NS-07-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH6-04-NS-08-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH6-05-NS-09-2.0-4.0	A <sup>3</sup> , R <sup>1</sup>	A <sup>2</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH6-05-NS-10-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH1-14-NS-27-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>1</sup> , J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH1-14-NS-28-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH1-15-NS-29-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH1-15-NS-30-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>2</sup>	J <sup>4</sup> , J <sup>6</sup> , R <sup>2</sup>	A <sup>4</sup>
BH2-06-NS-11-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH2-06-NS-12-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-10-NS-19-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-10-NS-20-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-11-NS-21-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-11-NS-22-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-12-NS 23-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-12-NS-24-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-13-NS 25-2.0-4.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH4-13-NS-26-4.0-6.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A <sup>4</sup>
BH1-15-E3-38-0-0	A <sup>1</sup>	A	J <sup>3</sup>	A <sup>5</sup> , J <sup>7</sup>	A <sup>4</sup>
BH4-12-E2-37-0-0	A <sup>1</sup>	A	J <sup>3</sup>	J <sup>7</sup>	A <sup>4</sup>
BH0-05-T5-35-0-0	A <sup>1</sup>	--	--	--	--
BH0-04-T4-34-0-0	A <sup>1</sup>	--	--	--	--

A - Accept all data.

A<sup>1</sup> - Accept data but estimate (UJ) all positive values for methylene chloride less than the action level due to blank contamination.

A<sup>2</sup> - Accept data but estimate (UJ) all positive values for acetone, methylene chloride, benzoic acid and 4-chloroaniline less than the action level due to blank contamination.

A<sup>3</sup> - Accept data but estimate (UJ) all positive values for acetone, methylene chloride, and trichloroethene less than the action level due to blank contamination.

A<sup>4</sup> - Qualify as estimated (UJ) all positive values for TPH less than 23 mg/kg due to blank contamination.

A<sup>5</sup> - Accept data but estimate (UJ) positive values for zinc less than 180 ug/l due to blank contamination.

J<sup>1</sup> - Estimate (J) positive results for dieldrin, endrin, and 4,4'-DDT due to MS/MSD interference.

J<sup>2</sup> - Estimate (J) positive results for endrin, and 4,4'-DDT in soil samples due to high blank spike recovery.

J<sup>3</sup> - Estimate (J) all positive results for alpha-BHC and 4,4'-DDT in water samples due to high blank spike recovery.

J<sup>4</sup> - Estimate (UJ) non-detects for silver for all soil samples

- because LCS and LCS spike duplicate did not meet criteria.
- J<sup>5</sup> - Estimate (J) positive results for calcium, magnesium, potassium and sodium for all soil samples due to high matrix spike recoveries.
  - J<sup>6</sup> - Estimate (J) all positive results for thallium, arsenic and mercury, and estimate (UJ) all negative results for thallium due to low soil matrix spike recoveries.
  - J<sup>7</sup> - Estimate (J) positive results and (UJ) non-detects for mercury in all water samples matrix spike recovery outside of criteria.
  - R<sup>1</sup> - Estimate (J) positive results and reject (R) non-detects due to VOA surrogates diluted out.
  - R<sup>2</sup> - Reject (R) non-detects for arsenic and mercury in all soil samples due to low matrix spike recoveries.



## HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L572

7 Aqueous: MW0-01-FD-81-0.0-0.0, MW0-02-FT-82-0.0-0.0,  
MW0-01-T1-79-0.0-0.0, MWA-08-NS-77-0.0-0.0,  
MWB-01-E1-78-0.0-0.0, MWB-01-NS-70-0.0-0.0,  
MW2-04-NS-73-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L572 low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . GC/MS Tuning
- \* . calibration
- . blanks
- \* . blank/spike control samples
- \* . blank/spike laboratory control samples
- \* . surrogate recoveries
- . matrix spike/matrix spike duplicate
- . pesticide instrument (GC) performance

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### ORGANICS

#### Blanks:

The pesticide/PCB, and TPH blanks contained no contaminants. The worst-case volatile and semivolatile TPH lab, equipment and trip blanks are summarized below:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	17 ug/l	170 ug/l
Acetone	14 ug/l	140 ug/l
Chloroform	2J ug/l	10 ug/l
Bis(2-ethylhexyl)phthalate	1 ug/l	10 ug/l

#### Blank Actions:

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

#### **Matrix Spike / Matrix Spike Duplicate:**

No SVOA MS/MSD was reported for this case. The VOA MS/MSD met all QC criteria. Gamma-BHC had a slightly high percent recovery for the pesticide/PCB fraction, however no action was necessary since there were no positive results.

#### **Pesticide Instrument (GC) Performance:**

A number of compounds were slightly outside their retention time windows. The peaks were checked for each of the four samples (FD-81, FT-82, NS-77, and E1-78) which seemed questionable. Professional judgement deemed that none of the four samples need be qualified.

### **INORGANICS**

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

#### **Blanks:**

Antimony, calcium, sodium, nickel, vanadium, and zinc contamination was found in the equipment blank and in the calibration and/or prep blanks associated with these samples. The action levels for these analytes were as follows:

Sb	225	ug/l
Ca	2080	ug/l
Ni	149	ug/l
Na	2875	ug/l
V	95	ug/l
Zn	91.5	ug/l

All positive results for these compounds which were less than the action level were qualified as estimated (UJ) due to blank contamination.

#### **Matrix Spike / Matrix Spike Duplicate:**

Soil matrix spike recoveries were low for arsenic, lead, selenium, silver, antimony, and thallium. Positive results (J) and non-detects (UJ) for these compounds were flagged as estimated. The non-detects for lead were not flagged as estimated, but were rejected (R) because its percent recovery was much less than 30%.

Hulman Field  
RFW # 9010L572

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
MW0-01-FD-81-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	A	A <sup>3</sup> , J <sup>1</sup> , R <sup>1</sup>	A
MW0-02-FT-82-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	A	J <sup>1</sup> , R <sup>1</sup>	A
MWA-08-NS-77-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	A	J <sup>1</sup> , R <sup>1</sup>	A
MWB-01-NS-70-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	A	A <sup>3</sup> , J <sup>1</sup> , J <sup>2</sup>	A
MWB-01-E1-78-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	A	A <sup>3</sup> , J <sup>1</sup>	A
MW2-04-NS-73-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A
MW0-01-T1-79-0.0-0.0	A <sup>1</sup>	--	--	--	--

A - Accept all data.

A<sup>1</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.

A<sup>2</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.

A<sup>3</sup> - Accept data but flag as estimated (UJ) all positive values for nickel, vanadium, zinc, antimony, calcium and sodium less than the action level due to blank contamination.

J<sup>1</sup> - Qualify as estimated (J) positive results and all (UJ) all non-detects for antimony, arsenic, selenium, silver and thallium due to low matrix spike recoveries.

J<sup>2</sup> - Estimate (J) positive results for lead due to low MS/MS recovery.

R<sup>1</sup> - Reject (R) non-detects for lead due to very low (<30%) matrix spike recoveries.

-- - Sample was not analyzed for this parameter.

## HULMAN DATA VALIDATION RESULTS SUMMARY

### Case No. RFW9010L576

4 Soils: SEB-01-NS-91-0.0-0.0, SE1-04-NS-94-0.0-0.0  
SE1-05-NS-95-0.0-0.0, SE4-03-NS-93-0.0-0.0

7 Aqueous: SE0-01-T1-98-0.0-0.0, SEB-01-E1-96-0.0-0.0  
SWB-01-E1-99-0.0-0.0, SEB-01-E1-96-0.0-0.0  
SW1-04-NS-86-0.0-0.0, SW1-05-NS-87-0.0-0.0,  
SW4-03-NS-85-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L576 low level soil and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- . holding times
- \* . GC/MS Tuning
- \* . calibration
- . blanks
- . blank/spike control samples
- \* . blank/spike laboratory control samples
- . surrogate recoveries
- . matrix spike/matrix spike duplicate
- . pesticide instrument (GC) performance

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### ORGANICS

#### Holding Times:

Holding time criteria were met for the VOA and the TPH extractions and analyses. The SVOA and pesticide/PCB samples were all extracted within the required holding time, but three of the pesticide samples were analyzed eight days over the required holding time. Results for these samples will be flagged as estimated: J for positives, UJ for non-detects.

#### Blanks:

The pesticide/PCB blanks contained no contaminants. The worst-case volatile, semivolatile, and TPH lab, equipment and trip blanks are summarized below:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	19 ug/kg	190 ug/kg (ug/l)

Acetone	21 ug/kg	150 ug/kg (ug/l)
Chloroform	1J ug/l	5 ug/l (ug/kg)
Chloromethane	2J ug/kg	10 ug/kg
Di-n-butylphthalate	66J ug/kg	660 ug/kg
Bis(2-ethylhexyl)phthalate	59J ug/kg	590 ug/kg
TPH	2.5 mg/kg	12.5 mg/kg

#### Blank Actions:

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

#### Blank/Spike Control Sample (BS/BSD):

The VOA and SVOA BS/BSD recoveries met QC criteria. The aqueous SVOA had low recoveries for 1,4-dichlorobenzene (27%, 30%) and for 1,2,4-trichlorobenzene (34%, 35%) while the aqueous pesticide fraction showed a high recovery for gamma-BHC (140). For the soil matrix BS/BSD, the VOA and SVOA recoveries were within QC criteria. The pesticide/PCB fraction showed a high recovery for dieldrin (152), low recovery for heptachlor (25), and interference with the recovery of gamma-BHC.

Positive results for these compounds will be flagged as estimated.

#### Surrogate Recoveries:

The surrogates which did not meet QC criteria are summarized below:

<u>TR#s</u>	<u>VOA</u> <u>TOL</u>	<u>PEST</u> <u>DBC</u>
MW1-06-NS-75		189
SE6-02-NS-92	139	Diluted out

Any positive VOA results for the above soil sample will be flagged (J) as estimated, and all positive pesticide results (soil and water) will be flagged (J) as estimated. Non-detected results will be rejected (R) for the soil pesticide fraction.

#### Matrix Spike / Matrix Spike Duplicate:

The volatile and pesticide/PCB matrix spike recoveries were within the specified criteria. 4-Nitrophenol and 2,4-dinitrotoluene had slightly high recoveries in the semivolatile fraction. No action

was necessary since there were no positive values for these compounds.

#### **Pesticide Instrument (GC) Performance:**

Retention time windows were outside of criteria for a number of compounds, however, the only sample chromatogram affected was that for MW6-03-NS-72. This sample was not qualified based on RT windows, but rather on the surrogate recovery which was diluted out by a 50x dilution. Other minor problems were noted during the pesticides data review, but no data qualifications resulted from these.

#### **INORGANICS**

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

#### **Blanks:**

Antimony, sodium and vanadium contamination was found in the water blank and sodium contamination was observed in the soil blank. Blank actions were necessary and were taken only for vanadium in the water samples. All vanadium hits less than 75 ug/l for the water samples were qualified as estimated due to blank contamination.

#### **Matrix Spike / Matrix Spike Duplicate:**

Soil matrix spike recoveries were low for arsenic, lead, and selenium and were high for zinc. No action was necessary for lead since the unspiked sample concentration exceeded the spiked sample concentration by more than four times the amount. Positive results for arsenic, selenium and zinc were flagged (J) as estimated, and non-detects for arsenic and selenium were rejected (R) since their MS/MSD recoveries were below 30%.

Water MS/MSD recoveries were high for aluminum, iron, lead and mercury and were low for antimony, arsenic, selenium, silver, and thallium. Positive results for all of these compounds except Al and Fe (which required no action) were flagged (J) as estimated. Non-detects for Sb, As, Se, and Tl were flagged (UJ) as estimated.

Hulman Field  
RFW # 9010L576

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
SEB-01-NS-91-0.0-0.0	A <sup>4</sup>	A <sup>4</sup>	A	A <sup>6</sup> , J <sup>5</sup> , R <sup>1</sup>	A <sup>5</sup>
SE1-04-NS-94-0.0-0.0	A <sup>4</sup>	A <sup>4</sup>	J <sup>1</sup> , J <sup>3</sup> , J <sup>4</sup>	A <sup>6</sup> , J <sup>5</sup>	A <sup>5</sup>
SE1-05-NS-95-0.0-0.0	A <sup>4</sup>	A <sup>4</sup>	J <sup>1</sup> , J <sup>4</sup>	A <sup>6</sup> , J <sup>5</sup>	A <sup>5</sup>
SE4-03-NS-93-0.0-0.0	A <sup>4</sup>	A <sup>4</sup>	--	--	A <sup>5</sup>
SWB-01-NS-83-0.0-0.0	A <sup>3</sup>	A <sup>3</sup>	A	J <sup>5</sup> , J <sup>6</sup>	A
SW1-04-NS-86-0.0-0.0	A <sup>3</sup>	A <sup>3</sup>	J <sup>2</sup>	J <sup>5</sup> , R <sup>1</sup>	A
SW1-05-NS-87-0.0-0.0	A <sup>3</sup>	A <sup>3</sup>	A	J <sup>5</sup> , R <sup>1</sup>	A
SW4-03-NS-85-0.0-0.0	A <sup>3</sup>	A <sup>3</sup>	--	--	A
SWB-01-E1-99-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	J <sup>1</sup>	J <sup>7</sup> , J <sup>8</sup>	A
SWB-01-E1-99-0.0-0.0ORE	--	J <sup>1</sup>	--	--	--
SEB-01-E1-96-0.0-0.0	A <sup>2</sup>	A <sup>2</sup>	--	--	A
SE0-01-T1-98-0.0-0.0	A <sup>1</sup>	--	--	--	--

A - Accept all data.

A<sup>1</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.

A<sup>2</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.

A<sup>3</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, chloromethane, and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.

A<sup>4</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, di-n-butylphthalate and bis(2-ethylhexyl)phthalate less than the action level due to blank contamination.

A<sup>5</sup> - Accept data but flag as estimated (UJ) all positive values for TPH less than 12.5 mg/kg due to blank contamination.

A<sup>6</sup> - Accept data but flag as estimated (UJ) positive results for nickel and vanadium less than the action level due to blank contamination.

J<sup>1</sup> - Qualify as estimated (J) positive results and (UJ) non-detects due to analyses holding times exceeded.

J<sup>2</sup> - Estimate (J) positive results for gamma-BHC due to high water MS/MSD recovery.

J<sup>3</sup> - Estimate (J) positive results for endrin, dieldrin, aldrin, and gamma BHC due to high soil MS/MSD recoveries.

J<sup>4</sup> - Estimated (J) all positive results for lindane due to high blank spike recovery.

J<sup>5</sup> - Estimate (J) all positive results and (UJ) all non-detects for

silver, arsenic, antimony, selenium, and thallium due to low matrix spike recoveries.

J<sup>6</sup> - Estimate (J) positive values for lead due to low matrix spike recovery.

R<sup>1</sup> - Reject (R) non-detects for lead in the water samples due to very low (<30%) matrix spike recoveries.

-- - Sample was not analyzed for this parameter.



## HULMAN DATA VALIDATION RESULTS SUMMARY

Case No. RFW9010L600

1 Soil: SE6-02-NS-92-0.0-0.0

7 Aqueous: MW5-02-NS-71-0.0-0.0, MW6-03-NS-72-0.0-0.0,  
MW4-05-NS-74-0.0-0.0, MW1-06-NS-75-0.0-0.0,  
MW5-07-NS-76-0.0-0.0, MW0-02-T2-80-0.0-0.0,  
MW0-03-NS-92-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case No. RFW#9010L600 low level soil and low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . GC/MS Tuning
- \* . calibration
- . blanks
- . blank/spike control samples
- \* . blank/spike laboratory control samples
- . surrogate recoveries
- . matrix spike/matrix spike duplicate
- . pesticide instrument (GC) performance

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### ORGANICS

#### Blanks:

The pesticide/PCB blanks contained no contaminants. The worst-case volatile, semivolatile and TPH lab, equipment and trip blanks are summarized below:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	15 ug/kg	150 ug/kg (ug/l)
Acetone	15 ug/l	150 ug/kg (ug/l)
Chloroform	2J ug/l	10 ug/l
4-Methyl-2-pentanone	2J ug/l	10 ug/l
2-Hexanone	3J ug/l	15 ug/l

Di-n-butylphthalate	66J ug/kg	660 ug/kg
Bis(2-ethylhexyl)phthalate	59J ug/kg	590 ug/kg
TPH	2.5 mg/kg	12.5 mg/kg

#### Blank Actions:

- . value < action level; report value followed by a UJ
- . value > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

#### Blank/Spike Control Sample (BS/BSD):

The VOA BS/BSD samples met QC criteria. The aqueous SVOA had low recoveries for 1,4-dichlorobenzene (27%, 30%) and for 1,2,4-trichlorobenzene (34%, 35%) while the aqueous pesticide fraction showed a high recovery for gamma-BHC (140). For the soil matrix BS/BSD, the VOA and SVOA recoveries were within QC criteria. The pesticide/PCB fraction showed a high recovery for dieldrin (152), low recovery for heptachlor (25), and interference with the recovery of gamma-BHC.

Positive results for these compounds will be flagged as estimated.

#### Surrogate Recoveries:

The surrogates which did not meet QC criteria are summarized below:

<u>TR#s</u>	<u>VOA</u> <u>TOL</u>	<u>PEST</u> <u>DBC</u>
MW1-06-NS-75		189
SE6-02-NS-92	139	Diluted out

Any positive VOA results for the above soil sample will be flagged (J) as estimated, and all positive pesticide results (soil and water) will be flagged (J) as estimated. Non-detected results will be rejected (R) for the soil pesticide fraction.

#### Matrix Spike / Matrix Spike Duplicate:

The volatile and pesticide/PCB matrix spike recoveries were within the specified criteria. 4-Nitrophenol and 2,4-dinitrotoluene had slightly high recoveries in the semivolatile fraction. No action was necessary since there were no positive values for these compounds.

### **Pesticide Instrument (GC) Performance:**

Retention time windows were outside of criteria for a number of compounds, however, the only sample chromatogram affected was that for MW6-03-NS-72. This sample was not qualified based on RT windows, but rather on the surrogate recovery which was diluted out by a 50x dilution. Other minor problems were noted during the pesticides data review, but no data qualifications resulted from these.

### **INORGANICS**

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

#### **Blanks:**

Antimony, sodium and vanadium contamination was found in the water blank and sodium contamination was observed in the soil blank. Blank actions were necessary and were taken only for vanadium in the water samples. All vanadium hits less than 75 ug/l for the water samples were qualified as estimated due to blank contamination.

#### **Matrix Spike / Matrix Spike Duplicate:**

Soil matrix spike recoveries were low for arsenic, lead, and selenium and were high for zinc. No action was necessary for lead since the unspiked sample concentration exceeded the spiked sample concentration by more than four times the amount. Positive results for arsenic, selenium and zinc were flagged (J) as estimated, and non-detects for arsenic and selenium were rejected (R) since their MS/MSD recoveries were below 30%.

Water MS/MSD recoveries were high for aluminum, iron, lead and mercury and were low for antimony, arsenic, selenium, silver, and thallium. Positive results for all of these compounds except Al and Fe (which required no action) were flagged (J) as estimated. Non-detects for Sb, As, Se, and Tl were flagged (UJ) as estimated.

Hulman Field  
RFW # 9010L600

TABLE I. RECOMMENDATIONS SUMMARY

SAMPLE ID#	VOA	SVOA	PEST/PCB	METALS	TPH
SE6-02-NS-92-0.0-0.0	A <sup>3</sup> , J <sup>1</sup>	A <sup>3</sup>	J <sup>2</sup> , J <sup>6</sup>	J <sup>9</sup> , R <sup>1</sup>	A <sup>4</sup>
MW6-03-NS-72-0.0-0.0	A <sup>2</sup>	J <sup>4</sup> , J <sup>5</sup>	A	J <sup>7</sup> , J <sup>8</sup>	A
MW4-05-NS-74-0.0-0.0	A <sup>2</sup>	J <sup>5</sup>	--	--	A
MW1-06-NS-75-0.0-0.0	A <sup>2</sup>	J <sup>5</sup>	J <sup>3</sup>	J <sup>7</sup> , J <sup>8</sup>	A
MW5-02-NS-71-0.0-0.0	A <sup>2</sup>	J <sup>5</sup>	--	A <sup>5</sup> , J <sup>7</sup> , J <sup>8</sup>	A
MW5-07-NS-76-0.0-0.0	A <sup>2</sup>	J <sup>5</sup>	A	J <sup>7</sup> , J <sup>8</sup>	A
MW0-02-T2-80-0.0-0.0	A <sup>1</sup>	--	--	--	--
MW0-03-T3-90-0.0-0.0	A <sup>1</sup>	--	--	--	--

A - Accept all data.

A<sup>1</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride and acetone less than the action level due to blank contamination.

A<sup>2</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, and chloroform less than the action level due to blank contamination.

A<sup>3</sup> - Accept data but flag as estimated (UJ) all positive values for methylene chloride, acetone, chloroform, 2-hexanone, and 4-methyl-2-pentanone less than the action level due to blank contamination.

A<sup>4</sup> - Accept data but flag as estimated (UJ) all positive values for TPH less than 12.5 mg/kg due to blank contamination.

A<sup>5</sup> - Accept data but flag as estimated (UJ) positive results for vanadium less than 75 ug/l for all water samples due to blank contamination.

J<sup>1</sup> - Qualify as estimated (J) positive results for SE6-02-NS-92-0-0 due to the surrogate compound toluene exceeding QC limits.

J<sup>2</sup> - Estimate (J) positive results and reject (R) non-detects for all compounds due to the surrogate compound dibutylchloroendate (DBC) being diluted out.

J<sup>3</sup> - Estimate (J) positive results due to high DBC recovery.

J<sup>4</sup> - Qualify as estimated (J) all positive results for 4-nitrophenol and 2,4-dinitrotoluene due to high matrix spike recoveries.

J<sub>5</sub> - Estimate (J) positive values for 1,2,4-trichlorobenzene and 1,4-dichlorobenzene due to low blank spike recoveries.

J<sub>6</sub> - Estimate (J) positive values and reject (R) non-detects for gamma-BHC to low blank spike recoveries.

J<sup>7</sup> - Estimate (J) all positive results and (UJ) all non-detects for silver, arsenic, antimony, selenium, and thallium due to low matrix spike recoveries.

J<sup>8</sup> - Estimate (J) positive values for lead and mercury due to high matrix spike recoveries.

J<sup>9</sup> - Qualify as estimated (J) all positive results for arsenic,

selenium and zinc in soil due to matrix spike recoveries outside of criteria.

- R<sup>1</sup> - Reject (R) non-detects for arsenic and selenium in soil due to very low (<30%) matrix spike recoveries.
- - Sample was not analyzed for this parameter.

March 30, 1992

Mr. Richard Westmoreland  
Hazardous Waste Remedial Action Program  
Martin Marietta  
P.O. Box 2009, FEDC Building  
Oak Ridge, Tennessee 37831

Re: Contract No. 43B-99791C  
Weston Analytical Laboratory  
Hulman ANG  
TPH: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5  
Volatiles: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5  
Semivolatiles: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5  
Pesticide/PCBs: 6 soils/SS6-16-NS-111-0.0-05 to SS6-21-NS-116-0.0-0.5

Dear Mr. Westmoreland:

A validation was performed on the organic analytical data from Case No. RFW #9201L056 soil samples collected by Metcalf & Eddy at the Hulman ANG site. The data was evaluated based on the following parameters:

- \* • data completeness
- holding times
- \* • GC/MS tuning
- calibration
- blanks
- blank spike/laboratory control sample
- surrogate recoveries
- matrix spike/matrix spike duplicate
- \* • internal standard performance
- \* • pesticide instrument performance
- \* • compound identification
- \* • compound quantitation

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### Holding Times:

The samples for TPH, volatile and pesticide/PCB analysis were all extracted and analyzed within the required holding time.

The samples for semivolatile analysis were initially extracted within the required holding time. However, during gel-permeation cleanup, the samples were lost due to a gel-permeation malfunction. Reserve portions of the extracts (prior to gel permeation) were diluted two-fold, analyzed and reported.

All of the samples for semivolatile analysis were reextracted seven days over the required holding time limit of fourteen days, while the analyses were performed within the required holding time. Only the results of the reextracted samples were validated and used flagging all positive results as estimated (J) and all non-detects as estimated (UJ).

### Calibration:

A number of compounds did not meet the specified criteria for the initial calibrations and the continuing calibrations for both volatile and semivolatile analyses. These are listed in the tables which follow.

A five-point standard curve was performed daily, and all correlation coefficients were 0.995 for the TPH analyses. In addition, pesticide/PCB continuing calibrations were out of criteria for aldrin, alpha-BHC, and gamma-BHC. Corresponding sample values are estimated (J) for positive values.

### Volatile Calibration

Instrument 1050W

Compound	IC 1/29/92	CC 1/30/92
Acetone	X	
Chloromethane	X	
4-Methyl, 2-pentanone		X
2-Hexanone		X
1,1,2,2-Tetrachloroethane		X
Samples Affected	All Samples	All Samples

# **Semivolatile Calibration**

Instrument 5100SP

Compound	CC 2/10/92	CC 2/11/92
2,2'-Oxybis(2-chloropropane)	X	
Pyrene		X
2,4-Dimethylphenol		X
2-Nitroaniline		X
4-Nitrophenol		X
Butylbenzylphthalate		X
bis(2-ethylhexyl)phthalate		X
Associated Samples	SS6-16-NS-111-0.0-0.5RE SS6-20-NS-115-0.0-0.5RE (MS/MSD) SS6-21-NS-116-0.0-0.5RE	

X - Percent RSD >30, Percent D >25; Estimate (J) all positive results.

+ -  $\bar{R}\bar{F}$ , RF <0.05; Estimate (J) all positive results and reject (R) all non detects.

**Note:** Data was flagged according to the above HAZWRAP criteria; however, note that all of the listed compounds except pyrene, 2,4-dimethylphenol and 1,1,2,2-tetrachloroethane no longer have a maximum %RSD or %D according to the 3/90 SOW.

## **Blanks:**

The TPH and pesticide/PCB blanks contained no contaminants. The semivolatile and volatile blanks are summarized in the following table which shows the maximum concentration for any of the method, trip, or equipment blanks:

Compound	Maximum Concentration (ug/l)	Action Level (ug/kg)
Methylene Chloride	5J	50
Acetone	10	100
Chloroform	2J	10
Di-n-butylphthalate	2J	660
Bis(2-ethylhexyl)phthalate	4J	1320



Mr. Richard Westmoreland  
March 30, 1992

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#### Blank Actions:

- Value < CRQL; report CRQL followed by a U
- Value > CRQL and < action level; report value followed by a U
- Value > CRQL and > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

#### Blank Spike/Laboratory Control Sample:

No laboratory control sample (LCS) was analyzed for the TPH or the volatile fractions. The recovery for phenol (98%) in the semivolatile fraction was slightly greater than the upper QC limit of 90%. No actions were taken based on LCS results.

#### Surrogate Recoveries:

The surrogates which did not meet criteria are summarized below:

TR Nos.	Percent Recoveries
	VOA
	BFB
SS6-16-NS-111-0.0-0.5RE	124

Weston, in their case narrative, reported that 21 of the soil surrogate recoveries for the semivolatile fraction were outside of QC limits. Re-analysis of the re-extracted, gel-permeated samples showed successful surrogate recoveries for all compounds. The following flags will be applied to the sample data for each sample outside of the Contract Required Recovery Range (CRR):

	Percent Recovery		
	<10%	10% - CRR	>CRR
Positive Sample Results	J	J	J
Non-detected Results	R	UJ	UJ

#### Matrix Spike and Matrix Spike Duplicates:

The recoveries of the Matrix Spike/Matrix Spike Duplicates (MS/MSD) for the volatiles and the pesticides/PCBs were within the Contract Required Recovery Range.

In the semivolatile fraction, the relative percent difference for pyrene was high. Recoveries for 4-nitrophenol, 2,4-dinitrotoluene and 4-chloro-3-methylphenol were also higher than the CRR. Pyrene was detected in the unspiked sample and flagged as indicated below.

Mr. Richard Westmoreland  
March 30, 1992

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The following actions will be applied to the unspiked sample data:

1. If any compound does not meet the Contract Required Recovery Range (CRR), the data will be flagged as stated below:

	Percent Recovery		
	<10%	10% - CRR	>CRR
Positive Sample Results	J	J	J
Non-detected Results	R	A	A

**Field Duplicates:**

Samples SS6-17-NS-112-0.0-0.5 and SS6-21-NS-116-0.0-0.5 were the reported field duplicates. HAZWRAP Level C criteria does not require that any action be taken based on field duplicates.

**Internal Standard Performance:**

Internal standard area counts were outside of the acceptable range for 1,4-difluorobenzene (IS2) and chlorobenzene-d<sub>5</sub> (IS3) in the volatile fraction, and for chrysene-d<sub>12</sub> (IS5) and perylene-d<sub>12</sub> (IS6) in the semivolatile fraction. No action was necessary for the semivolatile fraction since only blanks were analyzed following these standards. Qualification of the volatile data consisted of flagging positive results as estimated (J) and flagging negative results as estimated (UJ) for the compounds that were quantified using IS2 and IS3.

Sincerely,

METCALF & EDDY, INC.

*Donna Straker*

Donna Straker  
Reviewer

#### DATA SUMMARY KEY

- A - Acceptable data.
- J - The associated numerical value is an estimated quantity.
- R - Reject data due to quality control criteria. The data are unusable (compound may or may not be present). Resampling and reanalysis is necessary for verification.
- U - The compound was analyzed for but was not detected. The associated numerical value is the sample quantitation limit.
- UJ - The compound was analyzed for but was not detected. The sample quantitation limit is an estimated quantity.

Hulman ANG Site  
Case No. RFW#9201L056

TABLE I. RECOMMENDATIONS SUMMARY

TR Nos.	VOA	SVOA	Pesticide/PCB	TPH
SS6-16-NS-111-0.0-0.5 SS6-16-NS-111-0.0-0.5RE	A <sup>1</sup> ,A <sup>3</sup>	A <sup>3</sup> ,J <sup>1</sup>	A	A
SS6-17-NS-112-0.0-0.5 SS6-17-NS-112-0.0-0.5RE	A <sup>1</sup> ,A <sup>3</sup>	A <sup>3</sup> ,J <sup>1</sup>	A	A
SS6-18-NS-113-0.0-0.5 SS6-18-NS-113-0.0-0.5RE	A <sup>1</sup> ,A <sup>3</sup>	A <sup>3</sup> ,J <sup>1</sup>	A	A
SS6-19-NS-114-0.0-0.5 SS6-19-NS-114-0.0-0.5RE	A <sup>1</sup> ,A <sup>2</sup> ,A <sup>3</sup>	A <sup>3</sup> ,J <sup>1</sup>	A	A
SS6-20-NS-115-0.0-0.5 SS6-20-NS-115-0.0-0.5RE	A <sup>1</sup> ,A <sup>2</sup>	A <sup>3</sup> ,J <sup>1</sup>	A	A
SS6-21-NS-116-0.0-0.5 SS6-21-NS-116-0.0-0.5RE	A <sup>1</sup> ,A <sup>3</sup>	A <sup>3</sup> ,J <sup>1</sup>	A	A

A - Accept all data.

A<sup>1</sup> - Accept data but estimate (J) positive results for acetone, chloromethane, 2-hexanone, 4-methyl-2-pentanone, and 1,1,2,2-tetrachloroethane due to calibration QC limits being out of range.

A<sup>2</sup> - Accept data but flag as non-detect (U) all positive values for acetone, chloroform, methylene chloride and bis(2-ethylhexyl)phthalate at concentrations greater than the CRQL but less than the action level (210 and 2100 ug/kg, respectively) due to blank contamination.

A<sup>3</sup> - Accept data, report CRQL, and flag as non-detect (U) all positive values for acetone, chloroform, methyl chloride, di-n-butylethalate, and bis(2-ethylhexyl)phthalate detected at concentrations less than the CRQL due to blank contamination.

J<sup>1</sup> - Estimate (UJ) all non-detects and (J) all detects due to exceeded holding times.

## HULMAN DATA VALIDATION RESULTS SUMMARY

### INORGANICS

Case No. RFW9201L056

6 Soils:           SS6-16-NS-111-0.0-0.5, SS6-17-NS-112-0.0-0.5,  
                  SS6-18-NS-113-0.0-0.5, SS6-19-NS-114-0.0-0.5,  
                  SS6-20-NS-115-0.0-0.5, SS6-21-NS-116-0.0-0.5,

A validation was performed on the inorganic analytical data from Case No. RFW#9201L056 soil samples collected by M&E at the Hulman Municipal Airport site. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . calibration
- . blanks
- \* . blank/spike laboratory control samples
- . matrix spike/matrix spike duplicate

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

#### Blanks:

No contaminants were found in any of the equipment blanks associated with these samples. Antimony, thallium, vanadium, zinc, iron, and magnesium contamination was found in the calibration and/or prep blanks associated with these samples. Results for soil samples which contained these analytes at concentrations greater than the IDL, but less than the action level were qualified as estimated (J). The action levels for these analytes were as follows:

Antimony	28.5 mg/kg
Thallium	2.3 mg/kg
Vanadium	7.0 mg/kg
Zinc	4.4 mg/kg
Iron	90.1 mg/kg
Magnesium	113.0 mg/kg

**Matrix Spike / Matrix Spike Duplicate:**

Matrix spike recoveries for antimony, arsenic, lead, and selenium were outside of criteria. Positive values for these analytes were estimated (J) and non-detects (UJ) were also estimated. For arsenic non-detects will be rejected (R), due to extremely low recovery and the possibility that false negatives exist.

**Hulman Field  
RFW # 9201L056**

**TABLE I. RECOMMENDATIONS SUMMARY**

<b>SAMPLE ID#</b>	<b>METALS</b>
SS6-16-NS-111-0.0-0.5	A <sup>1</sup>
SS6-17-NS-112-0.0-0.5	A <sup>1</sup>
SS6-18-NS-113-0.0-0.5	A <sup>1</sup>
SS6-19-NS-114-0.0-0.5	A <sup>1</sup>
SS6-20-NS-115-0.0-0.5	A <sup>1</sup>
SS6-21-NS-116-0.0-0.5	A <sup>1</sup>

A<sup>1</sup> - Estimate (J) positive results for antimony, arsenic, lead and selenium and estimate (UJ) non-detects for antimony, lead, and selenium due to MS/MSD recoveries out of criteria.

## HULMAN DATA VALIDATION RESULTS SUMMARY

Case Nos. RFW9201L030, L056, L068, L073

17 Aqueous: MW0-01-FD-140-0.0-0.0, MW0-02-FT-141-0.0-0.0,  
MWA-08-NS-108-0.0-0.0, MW2-04-NS-104-0.0-0.0,  
MW6-03-NS-103-0.0-0.0, MW6-07-NS-107-0.0-0.0  
PZ4-01-NS-109-0.0-0.0, PZ4-01-NS-109-0.0-0.0  
MW4-05-NX-105-0.0-0.0, MW1-06-NX-106-0.0-0.0  
MWB-01-E1-133-0.0-0.0, MW1-06-E2-134-0.0-0.0,  
MW0-01-T1-117-0.0-0.0, MW0-02-T2-118-0.0-0.0,  
MW0-03-T3-119-0.0-0.0, MW0-04-T4-120-0.0-0.0,  
SS6-16-E2-134-0.0-0.0

A validation was performed on the organic and inorganic analytical data from Case Nos. RFW#9201L030, RFW#9201L056, RFW#9201L068, and RFW#9201L073, low level aqueous samples collected by M&E at the Hulman Municipal Airport site. The validation summaries for these cases were combined because the media is all water and the same QC results (MS/MSD, blanks, and initial calibrations) apply to these samples. The data was evaluated based on the following parameters:

- \* . data completeness
- \* . holding times
- \* . GC/MS Tuning
- . calibration
- . blanks
- . blank/spike laboratory control samples
- . surrogate recoveries
- . matrix spike/matrix spike duplicate
- \* . pesticide instrument (GC) performance
- \* . compound identification
- \* . compound quantitation

\* - All criteria were met for this parameter.

Table I summarizes the validation recommendations which were based on the following information:

### ORGANICS

#### Calibration:

A number of compounds did not meet the specified criteria for the initial calibrations and the continuing calibrations for both the volatile and the semivolatile analyses. These are listed in the tables which follow.

A five-point standard curve was performed daily, and all correlation coefficients were 0.995 for the TPH analysis. In addition, pesticide/PCB continuing calibrations were out of criteria for alpha-BHC, and gamma-BHC. Corresponding sample

values are estimated (J) for positive values and (UJ) for non-detects.

#### Volatile Calibration

Instrument 1050Q

Compound	IC 1/10/92	CC 1/20/92	CC 1/17/92 1/27/92 1/29/92	CC 1/28/92	CC 1/31/92
2-Butanone	+	+	+	+	+
Carbon tetrachloride		X			X
Chloroethane				X	
Bromoform					X

Associated Samples All Samples

#### Semivolatile Calibration

Instrument 5100SP

Compound	CC 1/31/92	CC 2/1/92	CC 2/3/92	CC 2/4/92
2,2'-Oxybis(2-chloropropane)		X	X	X
Isophorone		X	X	
Bis(2-chloroethoxy)methane			X	
Hexachlorocyclopentadiene	X		X	X
Carbazole		X	X	X
N-nitroso-di-n-propylamine				X
3-Nitroaniline	X	X	X	
Di-n-butylphthalate				X
3,3-Dichlorobenzidine	X	X		
Phenol		X		
2-Chlorophenol		X		

X - Percent RSD>30, Percent D>25; Estimate (J) all positive results

+ - RF, RF <0.05; Estimate (J) all positive results and reject (R) all non-detects.

**Note:** Data was flagged according to the above Hazwrap criteria: however, note that all of the listed compounds except carbon tetrachloride, bromoform, bis(2-chloroethoxy)methane, and isophorone no longer have a maximum %RSD or %D according to the 3/90 SOW.



**Blanks:**

The pesticide/PCB, and TPH blanks contained no contaminants. The worst-case volatile and semivolatile lab, equipment and trip blanks are summarized below:

<u>Compound</u>	<u>Max. Conc.</u>	<u>Action Level</u>
Low Level:		
Methylene Chloride	4J ug/l	40 ug/l
Acetone	10 ug/l	100 ug/l
Chloroform	5J ug/l	25 ug/l
Bis(2-ethylhexyl)phthalate	3 ug/l	30 ug/l
Diethylphthalate	4J ug/l	40 ug/l
Di-n-butylphthalate	4J ug/l	40 ug/l

**Blank Actions:**

- . value < CRQL; report CRQL followed by a U
- . value > CRQL and < action level; report value followed by a U
- . value > CRQL and > action level; report value unqualified

The action levels were compared to sample values and the appropriate data qualifications were made.

**Blank Spike / Laboratory Control Sample:**

No laboratory control sample (LCS) was analyzed for the TPH or the volatile fractions. Recoveries for 4-chloro-3-methylphenol and 4-nitrophenol were slightly higher than the QC limit. No actions were taken based on LCS results.

**Surrogate Recoveries:**

One acid surrogate spike (phenol-d5) for the SVOA fraction showed a low recovery (3%) for sample MW0-02-FT-141. No action was taken, since the lower advisory limit for this compound is 10% and the only sample affected was the tap water blank. Also, the MS/MSD analysis fulfilled its reanalysis requirement.

Surrogate recoveries for the pesticide/PCB fraction were outside acceptance criteria for the three equipment blanks and for samples MW6-03-NS-103, MW6-07-NS-107, and MW1-06-NX-106. Results for these samples will be estimated; (J) for positive values and (UJ) for non-detects.

**Matrix Spike / Matrix Spike Duplicate:**

The VOA MS/MSD met all QC criteria. Acenaphthene, 4-nitrophenol, pyrene, and 2,4-dinitrotoluene had high percent recoveries for the SVOA fraction and a couple of compounds for the pesticide/PCB fraction were also out of criteria. No action was taken with respect to MS/MSDs since there were no positive results for the associated SVOA samples and the pesticide/PCB results were previously flagged as estimated due to poor surrogate recoveries.

**Internal Standard Performance:**

A number of VOA and SVOA internal standards were outside of criteria. Reanalysis was done and produced similar results. No action was taken since the only samples analyzed following the out-of-control standards were blanks (one method blank and two field blanks, FD-140 and FT-141). The VOA standard applied only to the MSD sample.

**Compound Quantitation:**

The criteria stated in the 3/90 SOW were applied to duplicate injections with a %D greater than 25%. The lower value was reported as estimated (J) by the laboratory. No other actions were taken.

## INORGANICS

All criteria were met for holding times, calibration, lab control sample (LCS) and LCS duplicate spike for all samples.

### Blanks:

No contaminants were found in any of the equipment blanks associated with these samples. Antimony, thallium, vanadium, and zinc contamination was found in the calibration and/or prep blanks associated with the field QC samples and sample MWA-08-NS-108, while mercury and vanadium were found in those blanks associated with the other aqueous samples. The action levels for these analytes were as follows:

	Antimony	142.5 ug/l
	Thallium	11.5 ug/l
	Vanadium	35.0 ug/l
	Zinc	22.0 ug/l
and		
	Mercury	0.66 ug/l
	Vanadium	29.5 ug/l

All positive results for these compounds which were less than the action level were qualified as estimated (J) due to blank contamination.

### Matrix Spike / Matrix Spike Duplicate:

Matrix spike recoveries were low for aluminum, arsenic, selenium, silver, and thallium. Positive results (J) and non-detects (UJ) for these compounds were flagged as estimated. The MS recovery was higher than 125% for iron, so positive results for this analyte were flagged as estimated (J) and non-detects were accepted unqualified. The percent recovery for aluminum was only 10% but they were no non-detects for aluminum and therefore no need to reject data. The matrix spike recovery for dissolved silver was less than 30% so non-detects for this compound will be rejected for the associated sample.

**Hulman Field**  
**RFW # 9201L030, L056, L068, L073**

**TABLE I. RECOMMENDATIONS SUMMARY**

<b>SAMPLE ID#</b>	<b>VOA</b>	<b>SVOA</b>	<b>PEST/PCB</b>	<b>METALS</b>	<b>TPH</b>
MWA-08-NS-108-0.0-0.0	R <sup>1</sup>	A <sup>5</sup>	A <sup>6</sup>	A	A
MW6-03-NS-103-0.0-0.0	A <sup>2</sup> , R <sup>1</sup>	A	J <sup>1</sup>	A <sup>8</sup> , A <sup>9</sup>	A
MW6-07-NS-107-0.0-0.0	A <sup>2</sup> , R <sup>1</sup>	A <sup>5</sup>	J <sup>1</sup>	A <sup>8</sup> , A <sup>9</sup>	A
MW1-06-NX-106-0.0-0.0	A <sup>3</sup> , R <sup>1</sup>	A <sup>5</sup>	J <sup>1</sup>	A <sup>8</sup> , A <sup>9</sup> , R <sup>2</sup>	A
MWB-01-E1-133-0.0-0.0	A <sup>3</sup> , R <sup>1</sup>	A <sup>5</sup>	J <sup>1</sup>	A	A
MW1-06-E2-134-0.0-0.0	R <sup>1</sup>	A <sup>5</sup>	J <sup>1</sup>	A	A
SS6-16-E2-134-0.0-0.0	A <sup>2</sup> , A <sup>3</sup> , R <sup>1</sup>	A <sup>5</sup>	J <sup>1</sup>	A	A
PZ4-01-NS-109-0.0-0.0	R <sup>1</sup>	A <sup>5</sup>	--	--	A
PZ4-01-NS-110-0.0-0.0	A <sup>1</sup> , A <sup>3</sup> , R <sup>1</sup>	A <sup>5</sup>	--	--	A
MW4-05-NX-105-0.0-0.0	A <sup>3</sup> , R <sup>1</sup>	A <sup>5</sup>	--	--	A
MW2-04-NS-104-0.0-0.0	A <sup>2</sup> , A <sup>3</sup> , R <sup>1</sup>	A <sup>5</sup>	--	--	A
MW0-01-T1-117-0.0-0.0	A <sup>3</sup> , R <sup>1</sup>	--	--	--	--
MW0-02-T2-118-0.0-0.0	A <sup>3</sup> , R <sup>1</sup>	--	--	--	--
MW0-03-T3-119-0.0-0.0	A <sup>3</sup> , R <sup>1</sup>	--	--	--	--
MW0-04-T4-120-0.0-0.0	A <sup>1</sup> , A <sup>3</sup> , R <sup>1</sup>	--	--	--	--
MW0-01-FD-140-0.0-0.0	A <sup>3</sup> , A <sup>4</sup> , R <sup>1</sup>	A <sup>5</sup>	A	A	A
MW0-02-FT-141-0.0-0.0	A <sup>4</sup> , R <sup>1</sup>	A <sup>5</sup>	A	A	A

A - Accept all data.

A<sup>1</sup> - Accept data but estimate (J) positive values for carbon tetrachloride and bromoform due to calibration being out of range.

A<sup>2</sup> - Accept data but estimate (J) positive values for chloroethane due to calibration being out of range.

A<sup>3</sup> - Accept data, report CRQL, and flag as non-detect (U) all positive values for methylene chloride, acetone, and chloroform.

A<sup>4</sup> - Accept data but flag as non-detect (U) positive values for chloroform due to blank contamination.

A<sup>5</sup> - Accept data, report CRQL, and flag as non-detect (U) all positive values for bis(2-ethylhexyl)phthalate and di-n-butylphthalate less than the action level due to blank contamination.

A<sup>6</sup> - Accept data but estimate (J) positive values and estimate (UJ) non-detects for alpha-BHC and gamma-BHC due to calibration being out of range.

A<sup>7</sup> - Accept data but flag as estimated (J) positive values for zinc less than the action level due to blank contamination.

A<sup>8</sup> - Accept data but flag as estimated (J) all positive values for vanadium and mercury less than the action level due to blank contamination.

A<sup>9</sup> - Qualify as estimated (J) positive results and all (UJ) all non-detects for arsenic, selenium, silver and thallium due to

- low matrix spike recoveries.
- A<sup>10</sup> - Estimate (J) positive results for aluminum and iron due to MS/MSD recoveries out of criteria.
  - J<sup>1</sup> - Qualify as estimated (J) all positive results and all non-detects (UJ) for the pesticide fraction due to low surrogate recoveries.
  - R<sup>1</sup> - Reject (R) non-detects and estimate (J) positive results for 2-butanone due to calibration being out of range.
  - R<sup>2</sup> - Reject (R) non-detects for soluble silver due to very low (<30%) matrix spike recoveries.
  - - Sample was not analyzed for this parameter.

**DEVELOPMENT WATER ANALYTICAL DATA**



## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MWB -01

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW B010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW B010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW B010	TL	10/30/90
Bromobenzene	<10	UG/L	SW B010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW B010	TL	10/30/90
Bromoform	<10	UG/L	SW B010	TL	10/30/90
Bromomethane	<10	UG/L	SW B010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW B010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	SW B010	TL	10/30/90
Chlorobenzene	<10	UG/L	SW B010	TL	10/30/90
Chloroethane	<10	UG/L	SW B010	TL	10/30/90
Chloroform	13	UG/L	SW B010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW B010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW B010	TL	10/30/90
Chloromethane	<10	UG/L	SW B010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW B010	TL	10/30/90
Chlorotoluene	<10	UG/L	SW B010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW B010	TL	10/30/90
Dibromomethane	<10	UG/L	SW B010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW B010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW B010	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW B010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW B010	TL	10/30/90
1,1-Dichloroethane	<10	UG/L	SW B010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	SW B010	TL	10/30/90
1,1-Dichloroethylene	<10	UG/L	SW B010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW B010	TL	10/30/90
Dichloromethane	<10	UG/L	SW B010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW B010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW B010	TL	10/30/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW B010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW B010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW B010	TL	10/30/90
1,1,1-Trichloroethane	<10	UG/L	SW B010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	SW B010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW B010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW B010	TL	10/30/90

Approved by Michael Geller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.

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## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MWB - 01

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	<10	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	UG/L	SW 8020	TL	10/30/90

Approved by

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

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## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW5 - 02

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bromoform	<10	UG/L	SW 8010	TL	10/30/90
Bromomethane	<10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	SW 8010	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	SW 8010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	<10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW 8010	TL	10/30/90

Approved by

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

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## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW5 - 02

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	<10	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	UG/L	SW 8020	TL	10/30/90

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to contact the laboratory for clarification.

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## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW6 -03

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bromoform	<10	UG/L	SW 8010	TL	10/30/90
Bromomethane	<10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	SW 8010	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	SW 8010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	<10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW 8010	TL	10/30/90

Approved by \_\_\_\_\_

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.



## TEST RESULTS

=====

Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW6 -03

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	<10	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	UG/L	SW 8020	TL	10/30/90

Approved by

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

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## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW2 - 04

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bromoform	<10	UG/L	SW 8010	TL	10/30/90
Bromomethane	<10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	SW 8010	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	SW 8010	TL	10/30/90
Chloroform	35	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	<10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW 8010	TL	10/30/90

Approved by

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to contact the laboratory for clarification.



## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
CDC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW2 - 04

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	<10	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	UG/L	SW 8020	TL	10/30/90

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## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW04 -05

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW B010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW B010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW B010	TL	10/30/90
Bromobenzene	<10	UG/L	SW B010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW B010	TL	10/30/90
Bromoform	<10	UG/L	SW B010	TL	10/30/90
Bromomethane	<10	UG/L	SW B010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW B010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	SW B010	TL	10/30/90
Chlorobenzene	<10	UG/L	SW B010	TL	10/30/90
Chloroethane	<10	UG/L	SW B010	TL	10/30/90
Chloroform	<10	UG/L	SW B010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW B010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW B010	TL	10/30/90
Chloromethane	<10	UG/L	SW B010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW B010	TL	10/30/90
Chlorotoluene	<10	UG/L	SW B010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW B010	TL	10/30/90
Dibromomethane	<10	UG/L	SW B010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW B010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW B010	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW B010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW B010	TL	10/30/90
1,1-Dichloroethane	<10	UG/L	SW B010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	SW B010	TL	10/30/90
1,1-Dichloroethylene	<10	UG/L	SW B010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW B010	TL	10/30/90
Dichloromethane	<10	UG/L	SW B010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW B010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW B010	TL	10/30/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW B010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW B010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW B010	TL	10/30/90
1,1,1-Trichloroethane	<10	UG/L	SW B010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	SW B010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW B010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW B010	TL	10/30/90

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If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

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## TEST RESULTS

=====

Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW04 -05

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	<10	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	UG/L	SW 8020	TL	10/30/90

Approved by

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

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## TEST RESULTS

=====

Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
CDC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW1 - 06

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bromoform	<10	UG/L	SW 8010	TL	10/30/90
Bromomethane	<10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	SW 8010	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	SW 8010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	<10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW 8010	TL	10/30/90

Approved by

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to contact the laboratory for clarification.



## TEST RESULTS

=====

Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: MW1 - 06

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	13	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	UG/L	SW 8020	TL	10/30/90

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If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

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## TEST RESULTS

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Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: Piez. 1-B

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW 8010	TL	10/31/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW 8010	TL	10/31/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW 8010	TL	10/31/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/31/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/31/90
Bromoform	<10	UG/L	SW 8010	TL	10/31/90
Bromomethane	<10	UG/L	SW 8010	TL	10/31/90
Carbon tetrachloride	<10	UG/L	SW 8010	TL	10/31/90
Chloroacetaldehyde	<10	UG/L	SW 8010	TL	10/31/90
Chlorobenzene	<10	UG/L	SW 8010	TL	10/31/90
Chloroethane	<10	UG/L	SW 8010	TL	10/31/90
Chloroform	<10	UG/L	SW 8010	TL	10/31/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/31/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/31/90
Chloromethane	<10	UG/L	SW 8010	TL	10/31/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/31/90
Chlorotoluene	<10	UG/L	SW 8010	TL	10/31/90
Dibromochloromethane	11	UG/L	SW 8010	TL	10/31/90
Dibromomethane	<10	UG/L	SW 8010	TL	10/31/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/31/90
1,3-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/31/90
1,4-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/31/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/31/90
1,1-Dichloroethane	<10	UG/L	SW 8010	TL	10/31/90
1,2-Dichloroethane	<10	UG/L	SW 8010	TL	10/31/90
1,1-Dichloroethylene	<10	UG/L	SW 8010	TL	10/31/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/31/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/31/90
1,2-Dichloropropane	24	UG/L	SW 8010	TL	10/31/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/31/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/31/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/31/90
Tetrachloroethylene	13	UG/L	SW 8010	TL	10/31/90
1,1,1-Trichloroethane	<10	UG/L	SW 8010	TL	10/31/90
1,1,2-Trichloroethane	10	UG/L	SW 8010	TL	10/31/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/31/90
Trichlorofluoromethane	<10	UG/L	SW 8010	TL	10/31/90

Approved by

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.



## TEST RESULTS

=====

Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: Piez. 1-8

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/31/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/31/90
AROMATIC VOLATILE ORGANICS					
Benzene	37	UG/L	SW 8020	TL	10/31/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/31/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/31/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/31/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/31/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/31/90
Toluene	<10	UG/L	SW 8020	TL	10/31/90
Xylenes	<10	UG/L	SW 8020	TL	10/31/90

Approved by

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

Page 14 of 16



## TEST RESULTS

=====

Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: Trip Blank

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS					
Benzyl chloride	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroethoxy)methane	<10	UG/L	SW 8010	TL	10/30/90
Bis(2-chloroisopropyl)ether	<10	UG/L	SW 8010	TL	10/30/90
Bromobenzene	<10	UG/L	SW 8010	TL	10/30/90
Bromodichloromethane	<10	UG/L	SW 8010	TL	10/30/90
Bromoform	<10	UG/L	SW 8010	TL	10/30/90
Bromomethane	<10	UG/L	SW 8010	TL	10/30/90
Carbon tetrachloride	<10	UG/L	SW 8010	TL	10/30/90
Chloroacetaldehyde	<10	UG/L	SW 8010	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Chloroethane	<10	UG/L	SW 8010	TL	10/30/90
Chloroform	<10	UG/L	SW 8010	TL	10/30/90
1-Chlorohexane	<10	UG/L	SW 8010	TL	10/30/90
2-Chloroethyl vinyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chloromethane	<10	UG/L	SW 8010	TL	10/30/90
Chloromethylmethyl ether	<10	UG/L	SW 8010	TL	10/30/90
Chlorotoluene	<10	UG/L	SW 8010	TL	10/30/90
Dibromochloromethane	<10	UG/L	SW 8010	TL	10/30/90
Dibromomethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8010	TL	10/30/90
Dichlorodifluoromethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
trans-1,2-Dichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Dichloromethane	<10	UG/L	SW 8010	TL	10/30/90
1,2-Dichloropropane	<10	UG/L	SW 8010	TL	10/30/90
trans-1,3-Dichloropropylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,2,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,1,2-Tetrachloroethane	<10	UG/L	SW 8010	TL	10/30/90
Tetrachloroethylene	<10	UG/L	SW 8010	TL	10/30/90
1,1,1-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
1,1,2-Trichloroethane	<10	UG/L	SW 8010	TL	10/30/90
Trichloroethylene	<10	UG/L	SW 8010	TL	10/30/90
Trichlorofluoromethane	<10	UG/L	SW 8010	TL	10/30/90

Approved by Michael J. Heller

If you have any questions about your results, please do not hesitate to contact the laboratory for clarification.



## TEST RESULTS

=====

Report To: Ms. Deborah Simone  
Metcalf and Eddy, Inc.  
10 Harvard Mill Square  
Wakefield, MA 01880

Date Received: 10/24/90  
Date Complete: 11/05/90  
COC #: 4420

Sample Description: Water  
Sample Date: 10/24/90  
Sample ID: Trip Blank

TEST DESCRIPTION	RESULT	UNITS	METHOD	ANALYST	DATE
-----	-----	-----	-----	-----	-----
HALOGENATED VOLATILE ORGANICS - CONT.					
Trichloropropane	<10	UG/L	SW 8010	TL	10/30/90
Vinyl chloride	<10	UG/L	SW 8010	TL	10/30/90
AROMATIC VOLATILE ORGANICS					
Benzene	<10	UG/L	SW 8020	TL	10/30/90
Chlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,4-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,3-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
1,2-Dichlorobenzene	<10	UG/L	SW 8020	TL	10/30/90
Ethyl Benzene	<10	UG/L	SW 8020	TL	10/30/90
Toluene	<10	UG/L	SW 8020	TL	10/30/90
Xylenes	<10	UG/L	SW 8020	TL	10/30/90

Approved by \_\_\_\_\_

If you have any questions about your results, please do not hesitate  
to contact the laboratory for clarification.

Page 16 of 16

SUBJECT NAME	LOCATION
McTearl & Eddy	

## CHAIN OF CUSTODY RECORD

Please observe requested QA/QC.  
 PAGE      OF     

[illegible]



# CHAIN OF CUSTODY FORM

Lab/Project Name: <u>Hulman</u>		Job/Project Location: <u>Terre Haute, IN</u>		Job/Project Number: <u>005907-0000</u>													
Samplers: (Signatures) <u>T. Aebic</u>		Recorder: (Signature) <u>Todd Aebic</u>		Date: <u>10/24/90</u>													
Lab (Samples Sent To): <u>Valley Env.</u>		MATRIX		ANALYSIS REQUESTED													
SAMPLING		SAMPLE NUMBER		SAMPLE LOCATION		COMPOSITE/GRAB		PRESERVATIVE (Y/N)		VQA (8010)		VQA (8020)		Total #		COMMENTS	
Date	Time																
<u>10/24/90</u>	<u>920</u>																
<u>10/24/90</u>	<u>1015</u>																
<u>10/24/90</u>	<u>1055</u>																
<u>10/24/90</u>	<u>1150</u>																
<u>10/24/90</u>	<u>1405</u>																
<u>10/24/90</u>	<u>1300</u>																
<u>10/24/90</u>	<u>809</u>																
<u>10/24/90</u>	<u>730</u>																
Relinquished By: (Signature) <u>Todd Aebic</u>		Date: <u>10/24/90</u>		Time: <u>1535</u>		Received By: (Signature) <u>Cassie Spencer</u>		Date: <u>10/24/90</u>		Time: <u>1535</u>		Relinquished By: (Signature)		Date: <u>10/24/90</u>		Time: <u>1535</u>	
Relinquished By: (Signature)		Date:		Time:		Received By: (Signature)		Date:		Time:		Relinquished By: (Signature)		Date:		Time:	
Relinquished By: (Signature)		Date:		Time:		Received for Lab By: (Signature) <u>Cassie Spencer</u>		Date: <u>10/24/90</u>		Time: <u>3:35</u>		Comments:					
Method of Shipment:																	



**APPENDIX G**  
**Toxicity Profiles**

## **Acetone**

**Absorption** - Acetone is readily absorbed by all routes of exposures. It has been reported that approximately 71% of inhaled acetone vapor is absorbed (Clayton and Clayton, 1982).

**Distribution** - Due to the high water solubility of acetone, it is widely distributed in body tissues. Exposure to radio-labeled carbon in acetone has resulted in observations of the labeled carbon in cholesterol, hepatic glycogen, amino acids, and carcass proteins in rats (Clayton and Clayton, 1982).

**Metabolism** - No information was located.

**Carcinogenicity** - Mutagenicity has not been shown and there are no data on possible carcinogenicity, so acetone is presently classified in Group D, not classifiable as to human carcinogenicity (Table G-1) (U.S. EPA, 1993).

**Threshold Effects** - A concentration of 500 ppm acetone in air is an irritant to the eyes, nose, and throat (Clement Associates, 1985). Very high concentrations in air (10,000 ppm) will cause central nervous system (CNS) depression, slight decreases in organ and body weights, and intoxication, headaches, and insomnia (Clement Associates, 1985). Exposure to the skin can cause defatting resulting in leathery, cracked skin. Acetone increases the toxic effects of trichloroethane (U.S. EPA, 1984); this is a relationship known as potentiation. Increased liver and kidney weights and nephrotoxicity have been documented following oral exposures of rats to acetone. Based on the above critical effects, a chronic oral RfD of 0.1 mg/kg/day has been developed by the U.S. EPA using an uncertainty factor of 1000 (U.S. EPA, 1993).

**Reproductive/Developmental Effects** - No information was located.

## References

- Clayton and Clayton, 1982. Patty's Industrial Hygiene and Toxicology. Volume IIC - Toxicology. Third Revised Edition.
- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- U.S. EPA, 1984. Health Effects Assessment for Acetone. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Acetone, dated 8/2/93.

**TABLE G-1. WEIGHT OF EVIDENCE CLASSIFICATION**

Group	Description
A	Human carcinogen
B1 or B2	Probable human carcinogen
	B1 indicates that limited human data are available
	B2 indicates sufficient evidence in animals and inadequate or no evidence in humans
C	Possible human carcinogen
D	Not classifiable as to human carcinogenicity
E	Evidence of noncarcinogenicity for humans

Source: U.S. EPA. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A) Interim Final, December 1989.

## **2-Butanone (Methyl Ethyl Ketone)**

**Absorption** - The absorption of 2-butanone resulting from exposure via inhalation or ingestion has been verified, but not quantified (U.S. EPA, 1984). Dermal absorption of 2-butanone is rapid from an aqueous solution.

**Distribution** - At high doses, 2-butanone affects the nervous system and irritates the eyes, mucous membranes, and skin (U.S. EPA, 1984).

**Metabolism** - No information available.

**Carcinogenicity** - 2-Butanone is classified in Group D based on lack of human carcinogenicity data and inadequate animal data (U.S. EPA, 1993).

**Threshold Effects** - Rat drinking water studies resulted in a chronic oral RfD based on decreased fetal birth weights. The chronic oral RfD is 0.6 mg/kg/day (U.S. EPA, 1993). For inhalation, the chronic RfC is 1.0 mg/m<sup>3</sup> (U.S. EPA, 1993). Decreased fetal birth weights in mice is the critical effect.

**Reproductive/Developmental Effects** - Inhalation exposures to pregnant rats at levels of 500 ppm 2-butanone resulted in skeletal abnormalities and gross external and internal soft-tissue anomalies (U.S. EPA, 1984).

## **References**

- U.S. EPA, 1984. Health Effects Assessment for 2-Butanone. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 2-Butanone, dated 6/2/93.

## **Chloromethane**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Based on a 24 month inhalation study with mice, chloromethane has been classified in Group C, a possible human carcinogen (U.S. EPA, 1994). An inhalation slope factor of  $6.3 \times 10^{-3}$  per mg/kg/day was derived from this study; tumors of the kidney were observed (U.S. EPA, 1994). Based on route to route extrapolation an oral slope factor of  $1.3 \times 10^{-2}$  per mg/kg/day has been derived (U.S. EPA, 1994).

**Threshold Effects** - A risk assessment for this substance is under review by an EPA work group (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - No information available.

## **References**

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Chloromethane, dated 5/1/92.

U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual - FY 1994. Office of Research and Development - Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).

## **Methylene Chloride**

**Absorption** - Methylene chloride absorption occurs primarily via inhalation and ingestion. Some dermal absorption also occurs but at a slower rate (U.S. PHS, 1989).

**Distribution** - Following absorption, methylene chloride is quickly distributed to a wide range of tissues and body fluids. There is evidence of methylene chloride accumulation in body fats (U.S. PHS, 1989).

**Metabolism** - Methylene chloride is metabolized via two metabolic pathways; the mixed function oxidase system (MFO), where carbon monoxide and carbon dioxide are produced, and the glutathione S-transferase system (GST), which metabolizes methylene chloride at low exposures (U.S. PHS, 1989). Urinary excretion of methylene chloride has been observed in humans following inhalation exposure (U.S. PHS, 1989).

**Carcinogenicity** - Based on inhalation and drinking water studies with mice, methylene chloride has been classified in Group B2, a probable human carcinogen. Based on the development of lung tumors as a result of inhalation exposure, an inhalation unit risk of  $4.7 \times 10^{-7}$  per  $\mu\text{g}/\text{m}^3$  was generated. An oral slope factor of  $7.5 \times 10^{-3}$  per  $\text{mg}/\text{kg}/\text{day}$  was derived based on the development of liver tumors in mice (U.S. EPA, 1992).

**Threshold Effects** - Based on a 2-year chronic oral drinking water study of rats, a chronic oral RfD of  $6 \times 10^{-2}$   $\text{mg}/\text{kg}/\text{day}$  was developed (U.S. EPA, 1992). Liver toxicity was the critical effect observed. Based on a 2-year chronic inhalation study, a chronic inhalation RfC of 3  $\text{mg}/\text{m}^3$  was derived; the critical effect reported was liver toxicity (U.S. EPA, 1994). An uncertainty factor of 100 was used for both studies (U.S. EPA, 1992; 1994).

**Reproductive/Developmental Effects** - Limited studies suggest that inhalation of methylene chloride at concentrations of 1250 ppm and above results in developmental and maternal toxicity (U.S. PHS, 1989).

## References

- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Methylene Chloride, dated 1/20/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY - 1994. Office of Research and Development - Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).
- U.S. Public Health Service (U.S. PHS), 1989. Toxicological Profile for Methylene Chloride.

### 1,2-Dichloroethene (trans)

**Absorption** - No studies were located; however, on the basis of its physical characteristics, environmental concentrations of this compound are expected to be readily absorbed through the skin and lungs, and by ingestion (U.S. EPA, 1987).

**Distribution** - No information available.

**Metabolism** - In vitro hepatocytes are known to metabolize cis-1,2-DCE at a faster rate than trans-1,2-DCE (U.S. EPA, 1987).

**Carcinogenicity** - No information on carcinogenicity is provided on IRIS (U.S. EPA, 1992).

**Threshold Effects** - The subchronic oral RfD for trans-1,2-dichloroethene was generated from a NOEL of 17 mg/kg/day resulting from a 90-day, subchronic drinking water study on mice. The critical effect was increased serum alkaline phosphatase in male mice. Doses ranged from 17 to 452 mg/kg/day. An uncertainty factor of 1000 was used to compensate for possible inter-species differences, uncertainty in the threshold for sensitive humans, and uncertainty when extrapolating from subchronic to chronic exposures. The chronic oral RfD generated from this study is  $2 \times 10^{-2}$  mg/kg/day (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - No information available.

## **References**

- U.S. EPA, 1987. Health Advisory for 25 Organic Chemicals. March 31, 1987. Office of Drinking Water. Washington, D.C.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; 1,2-Dichloroethene (trans), dated 1/22/92.

## **1,2-Dichloroethene (cis)**

**Absorption** - No studies were located; however, on the basis of its physical characteristics, environmental concentrations of this compound are expected to be readily absorbed through the skin and lungs, and by ingestion (U.S. EPA, 1987).

**Distribution** - No information available.

**Metabolism** - In vitro hepatocytes are known to metabolize cis-1,2-DCE at a faster rate than trans-1,2-DCE (U.S. EPA, 1987). The rat liver converts cis-1,2-DCE to dichloroethanol and dichloroacetic acid (U.S. EPA, 1987).

**Carcinogenicity** - cis-1,2-Dichloroethene is listed in Group D, not classifiable. This is based on the lack of data from humans and animals and generally nonpositive results in mutagenicity assays (U.S. EPA, 1992).

**Threshold Effects** - The subchronic oral RfD for cis-1,2-dichloroethene is  $1 \times 10^{-1}$  mg/kg/day based on decreased hematocrit and hemoglobin in a 90-day rat study. A chronic oral RfD of  $1 \times 10^{-2}$  mg/kg/day was extrapolated from this study based on an uncertainty factor of 3,000 (U.S. EPA, 1994).



**Reproductive/Developmental Effects** - No information available.

## **References**

- U.S. EPA, 1987. Health Advisory for 25 Organic Chemicals. March 31, 1987. Office of Drinking Water. Washington, D.C.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; 1,2-Dichloroethene (cis), dated 1/22/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY - 1994. Office of Research and Development - Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).

## **Trichloroethene**

**Absorption** - Trichloroethene (TCE) is readily absorbed via the lungs and gastrointestinal tract. The lungs absorb TCE at a high initial rate, and continue to absorb TCE as equilibrium is reached. Oral exposure studies in rats show that over 90% of TCE is absorbed. The rate of absorption following dermal exposure is dependent on the physical state of trichloroethene encountered; absorption of the vapor through the skin is negligible compared to the liquid, which is readily absorbed through the skin (U.S. PHS, 1988).

**Distribution** - Data from animal studies indicate trichloroethene accumulates in the brain, liver, lungs, and adipose tissue following either inhalation or oral exposure (U.S. PHS, 1988).

**Metabolism** - Although metabolic pathways for trichloroethene are not well understood, three major and one minor urinary metabolite have been identified. Specifically, absorbed trichloroethene is converted to trichloroethanol, trichloroethanol glucuronide, trichloroacetic acid, and chloral hydrate (a minor urinary metabolite) by the liver. In addition, results from animal studies indicate that metabolism may occur in the bronchi, kidneys, and lungs (U.S. PHS, 1988). TCE itself is excreted via the lungs.

**Carcinogenicity** - Trichloroethene was formally classified by the EPA as a group B2, probable human carcinogen. The carcinogen assessment summary has been withdrawn from IRIS and HEAST; a slope factor is currently not available on IRIS or HEAST (U.S. EPA, 1994a; 1994b).

**Threshold Effects** - Threshold effects observed in animals include CNS depression, increased liver weights, renal dysfunction, suppressed immune response, and inhibition of an enzyme important in heme synthesis (U.S. PHS, 1988). Oral and inhalation RfDs are currently under review (U.S. EPA, 1994a).

**Reproductive/Developmental Effects** - Data from studies with mice and rats indicate that only the male reproductive system is affected by trichloroethene exposure: sperm motility is reduced and the incidence of morphological abnormalities in sperm is increased. Studies with rats indicate that the following fetotoxic developmental effects may occur from exposure to trichloroethene: skeletal ossification anomalies, decreased fetal weight, and behaviors indicative of delayed development (U.S. PHS, 1988).

## **References**

- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Trichloroethene, dated 7/6/94.
- U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY - 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303(94-1).
- U.S. Public Health Service, 1988. Toxicological Profile for Trichloroethene

## **Tetrachloroethene**

**Absorption** - Absorption of tetrachloroethene (PCE) following inhalation exposure or ingestion is rapid and nearly complete. Dermal absorption of dissolved PCE has been shown to be insignificant (U.S. PHS, 1988).

**Distribution** - Tetrachloroethene is primarily distributed to the adipose tissue following inhalation exposure in animals. In addition, there was some accumulation noted in the brain and liver (U.S. PHS, 1988).

**Metabolism** - Metabolic pathways for tetrachloroethene are different in study animals and humans. In humans, the primary metabolites found following inhalation and oral exposure are trichloroacetic acid and trichloroethanol (U.S. PHS, 1988). Oxalic acid is an important metabolite in some animals that has not been reported in humans (U.S. PHS, 1988).

**Carcinogenicity** - Tetrachloroethene has in the past been classified in Group B2, probable human carcinogen. A final decision on its classification as a Group B2 or C carcinogen has not yet been made; a slope factor is currently not available on IRIS or HEAST (U.S. EPA, 1992; 1994).

**Threshold Effects** - The chronic oral RfD determined for tetrachloroethene is  $1.0 \times 10^{-2}$  mg/kg/day (U.S. EPA, 1992). This chronic RfD was derived from a subchronic study in mice with hepatotoxicity as the critical effect.

**Reproductive/Developmental Effects** - Little information exists concerning reproductive effects resulting from tetrachloroethene exposure. A study of mice which looked at inhalation of tetrachloroethene, observed sperm abnormalities. Additional inhalation studies in animals resulted in fetotoxic developmental effects including skeletal ossification anomalies and behavioral performance and brain neurochemistry effects (U.S. PHS, 1988).

## References

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Tetrachloroethene. dated 4/6/92.

U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY - 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303(94-1).

U.S. Public Health Service, 1988. Toxicological Profile for Tetrachloroethene.

### **Carbon Disulfide**

**Absorption** - Studies indicate that carbon disulfide is readily absorbed in humans and animals following inhalation exposure. Significant absorption via the dermal route occurs in humans and animals (U.S. PHS, 1990).

**Distribution** - Once absorbed via inhalation, carbon disulfide is taken up by the blood and distributed throughout the body, especially to lipid-rich tissues and organs like the brain and liver. Studies regarding absorption in humans by oral exposure could not be located (U.S. PHS, 1990).

**Metabolism** - Proposed metabolic pathways suggest that carbon disulfide is metabolized to an unstable oxygen intermediate; which after several reactions ultimately result in the formation of a sulfate or other nonvolatile metabolite (U.S. PHS, 1990). In the liver, carbon disulfide reacts with amino acids to form thiocarbonate.

**Carcinogenicity** - No data is available for a carcinogenicity assessment (U.S. EPA, 1992).

**Threshold Effects** - Carbon disulfide affects the central nervous system, cardiovascular system, eyes, kidneys, liver and skin. A subchronic oral NOEL was found to be 11.0 mg/kg/day in a rabbit inhalation teratogenic study (U.S. EPA, 1992). Rabbits underwent inhalation exposure during the entire length of pregnancy and also 34 weeks before breeding to simulate occupational exposure. One oral study resulted in adverse effects to rabbit fetuses; fetotoxicity and fetal malformations were observed in rabbits. The chronic oral RfD of  $1 \times 10^{-1}$  mg/kg/day was

derived by the EPA based on this study (U.S. EPA, 1992). This RfD may change in the near future pending the outcome of a further review being conducted by the RfD work group (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - Studies indicate that exposure to carbon disulfide results in human reproductive effects such as decreased sperm count and decreased libido in men and intestinal regularities in women (U.S. PHS, 1990). These observations have been supported in animal studies (U.S. EPA, 1992). No developmental effects have been observed in the offsprings of men or women occupationally exposed to carbon disulfide.

## **References**

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Carbon Disulfide, dated 1/22/92.

U.S. Public Health Service, 1990. Toxicological Profile for Carbon Disulfide.

## **Benzene**

**Absorption** - Upon inhalation, benzene is quickly absorbed by the lung. Human data suggests that complete saturation of body tissues and fluids may require several days (U.S. PHS, 1989). Case studies suggest that upon oral ingestion, benzene is readily absorbed by humans and may be fatal at oral doses ranging from 9 to 30 grams (U.S. PHS, 1989). Benzene absorption through the skin occurs but at a rate lower than that for inhalation and ingestion exposures.

**Distribution** - Benzene is relatively insoluble in body fluids, and because of its high lipid solubility, it accumulates in fatty tissues. Human data indicate that following exposure, benzene is widely distributed by the blood. Target systems include the circulatory system, central nervous system, and the immune system (U.S. PHS, 1989).

**Metabolism** - In humans, the liver is the primary site of benzene metabolism. Evidence suggests that benzene toxicity is produced by one or more metabolites rather than by benzene itself. Conversion to benzene oxides is followed by the formation of phenol, the major metabolite (U.S. PHS, 1989).

**Carcinogenicity** - Based on studies showing an increased incidence of nonlymphocytic leukemia from occupational exposure and increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, benzene is classified in Group A, a known human carcinogen (U.S. EPA, 1994). Human data do show a statistically significant increase in leukemias. The oral slope factor of  $2.9 \times 10^{-2}$  per mg/kg/day was derived from human data for inhalation exposures (U.S. EPA, 1994).

**Threshold Effects** - Chronic exposure to benzene has been shown to cause a decrease in one or more of the circulating elements of the blood. Currently no RfD is available from the EPA (U.S. EPA, 1994).

**Reproductive/Developmental Effects** - Benzene has been demonstrated as an embryotoxic and fetotoxic compound in study animals as evidenced by increased incidents of resorption, reduced fetal weight and skeletal variations (U.S. PHS, 1989). In humans, benzene has not been identified as teratogenic.

## **References**

- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzene, dated 2/7/94.
- U.S. Public Health Service, 1989. Toxicological Profile for Benzene.

## **Toluene**

**Absorption** - Toluene is readily absorbed through the respiratory tract, less readily through the gastrointestinal tract and to an even lesser extent through the skin (U.S. PHS, 1988).

**Distribution** - Limited data exist concerning the distribution of toluene in human tissue. However, due to this compound's low water solubility, toluene is expected to distribute to and accumulate lipid tissue and bone marrow (U.S. PHS, 1988). Toluene administered orally or by inhalation to rats resulted in high levels in adipose tissue and bone marrow and lower concentrations in the liver and kidneys (U.S. PHS, 1988).

**Metabolism** - In humans and animals, approximately 60 to 70 percent of an absorbed dose of toluene is metabolized to hippuric acid, which is excreted in urine. Some toluene is excreted, unchanged, in expired air (U.S. PHS, 1988).

**Carcinogenicity** - Various studies have examined the carcinogenicity of toluene in mice as a result of direct dermal application and no incidence of skin or systemic tumors was demonstrated (U.S. EPA, 1994). Toluene has not been found to be mutagenic and is classified as a Group D compound by U.S. EPA (U.S. EPA, 1994).

**Threshold Effects** - Acute exposure to toluene, approximately 200 ppm can result in acute central nervous system (CNS) toxicity such as fatigue, headache, nausea, and confusion. Chronic exposure also affects the CNS with symptoms of ataxia (inability to coordinate body movements), tremors, impaired speech, vision, hearing, and memory (U.S. PHS, 1988). A subchronic gavage study in rats provided appropriate data from which the U.S. EPA derived an oral RfD. The chronic RfD of  $2 \times 10^{-1}$  mg/kg/day (with an uncertainty factor of 1,000) for oral exposure is based on increases in liver and kidney weights in rats (U.S. EPA, 1994).

**Reproductive/Developmental Effects** - Exposure to toluene has resulted in a significant increase in fetal mortality, a decrease in birth weights, and an increase in cleft palates in mice (U.S. EPA, 1984).

## **References**

U.S. EPA, 1984. Health Effects Assessment for Toluene. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Toluene, dated 4/6/94.

U.S. Public Health Service, 1988. Toxicological Profile for Toluene.

## **1,2-Dichlorobenzene**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - 1,2-Dichlorobenzene is classified in Group D due to lack of data and evidence of both negative and positive trends for carcinogenic responses in rats and mice (U.S. EPA, 1992).

**Threshold Effects** - Based on a 2-year gavage study in rats and mice, and a 13-week gavage study in rats and mice, where liver to body weight ratio increases were observed in the rats, a NOAEL of 120 mg/kg/day was derived (U.S. EPA, 1992). An oral uncertainty factor of 1000 was used to compensate for uncertainty in the extrapolation of dose levels from laboratory animals to humans, uncertainty in the threshold for sensitive humans, and uncertainty resulting



from the lack of studies assessing reproductive effects and adequate chronic toxicity in a second species. The chronic oral RfD was derived to be  $9 \times 10^{-2}$  mg/kg/day based on the NOAEL and uncertainty factor (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - No information available.

## References

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; 1,2-Dichlorobenzene, dated 1/22/92.

## 1,2-Dichloroethane

**Absorption** - In animal studies of 1,2-dichloroethane absorption, nearly all of the compound administered orally was absorbed, both from a corn oil vehicle and a water vehicle (U.S. EPA, 1984). Rapid pulmonary absorption has been inferred from the physical characteristics of 1,2-dichloroethane (U.S. EPA, 1984).

**Distribution** - Distribution of 1,2-dichloroethane is little dependent on route of administration. The compound tends to distribute into fatty tissues (U.S. EPA, 1984).

**Metabolism** - Lag times in the expression of toxicity to 1,2-dichloroethane suggest either that a detoxification system of conjugation with glutathione is saturable, or that an unknown activation reaction is part of the toxicology of the compound (U.S. EPA, 1984).

**Carcinogenicity** - The carcinogenicity of 1,2-dichloroethane was tested in one NCI-sponsored gavage study, which included rats and mice. The occurrence of forestomach squamous cell carcinomas, hemangiosarcoma (a blood vessel tumor), subcutaneous tissue fibroma, mammary adenocarcinoma, alveolar/bronchiolar adenoma, hepatocellular carcinoma, and endometrial

stromal polyps and sarcoma, in either male or female rats or mice was elevated in the high dose groups relative to controls (U.S. EPA, 1984).

Both dermal and inhalation studies failed to show a carcinogenic effect (U.S. EPA, 1984). No epidemiologic evidence of the carcinogenicity of 1,2-dichloroethane was found (U.S. EPA, 1984). The compound is classified as a Group B2 carcinogen, indicating that it is a probable human carcinogen (U.S. EPA, 1993).

Based on the induction of several tumor types in rats and mice treated by gavage, and lung papillomas in mice after topical application, EPA calculated an oral slope factor of  $9.1 \times 10^{-2}$  per mg/kg/day, and a unit risk of  $2.6 \times 10^{-5}$  per  $\mu\text{g}/\text{m}^3$  for inhalation exposures (U.S. EPA, 1993).

**Threshold Effects** - Oral exposures to 1,2-dichloroethane have been evaluated only in laboratory animals, at various dose rates including 50 mg/kg/day. At this dose rate, mice had decreased growth rates, decreased water consumption, and depressed leukocyte counts. High mortality was observed in both rats and mice at higher dosages (U.S. EPA, 1984).

There are many reports of toxicity from repeated exposures to 1,2-dichloroethane vapor in the workplace. Most of the reports do not estimate exposure concentration; in one large study, however, it was estimated that average workday concentrations were 15 ppm. Reported symptoms and diagnoses from occupational exposures included the following: fatigue, nervousness, nausea, vomiting, diarrhea, anorexia, eye and respiratory tract irritation, epigastric pain, tender liver, gall bladder and liver disease, loss of reflexes, loss of muscle tone, tongue tremors, slowed heartbeat, and hyperthyroidism (U.S. EPA, 1984). Damage to the kidneys and adrenal glands may also occur. Few specific changes were found in inhalation studies performed on animals.

No EPA reference doses are available for evaluation of threshold effects (U.S. EPA, 1993).

## References

- U.S. EPA, 1984. Health Effects Assessment for 1,2-Dichloroethane. September, 1984. EPA/540/1-86/051.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 1,2-Dichloroethane, dated 7/1/93.

## Benzoic Acid

**Absorption** - Benzoic acid is absorbed rapidly and completely by the gastrointestinal tract (U.S. EPA, 1993). No studies were found on inhalation or dermal absorption.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Benzoic acid is classified in Group D due to a lack of data from human and animal studies (U.S. EPA, 1993).

**Threshold Effects** - The oral RfD of 4 mg/kg/day for chronic exposures is based on the human daily per capita maximum intake values for benzoic acid and sodium benzoate (U.S. EPA, 1993). In the stomach both exist in their ionized form which is readily absorbed in the gastrointestinal tract. No toxic effects have been reported (U.S. EPA, 1993). The only adverse effects documented are malaise and decreased food and water intake.

**Reproductive/Developmental Effects** - Sodium benzoate, which exists in the same form as benzoic acid in the gastrointestinal tract, appears to have no maternal, fetal, or teratogenic toxicity in mice, rats, hamsters, or rabbits (U.S. EPA, 1993).

## References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Benzoic Acid, dated 7/1/93.

## Phenol

**Absorption** - Phenol is quickly absorbed by the inhalation, dermal, and oral route in humans and a variety of other mammalian species. Absorption of phenol from the small intestine appears to be quite rapid in the rat upon oral administration (U.S. PHS, 1988).

**Distribution** - In rabbits and rats, distribution of phenol occurs very rapidly and the highest concentrations are found in the liver, followed by lungs, blood, brain and spinal chord and kidney (U.S. PHS, 1988).

**Metabolism** - The primary urinary metabolites for phenol in mammals are as follows: phenyl glucuronide, phenyl sulfate, 1,4-dihydroxybenzene glucuronide and 1,4-dihydroxybenzene sulfate. Carbon dioxide has also been suggested as a significant phenol metabolite, especially in rabbits (U.S. PHS, 1988).

**Carcinogenicity** - Phenol has been classified in Group D, not classifiable as to human carcinogenicity, based on lack of human carcinogenicity data and inadequate animal data (U.S. EPA, 1992).

**Threshold Effects** - Exposure to phenol can result in short term effects such as burning pain in the mouth and throat, bloody diarrhea, pallor, sweating, weakness, headache and dizziness from inhalation; skin exposure may cause pain followed by numbness (U.S. EPA, 1992). A chronic oral RfD of  $6 \times 10^{-1}$  mg/kg/day is based on the NOAEL of 60 mg/kg/day generated from an oral development gavage study performed on rats (U.S. EPA, 1992). This study indicated that phenol administered to pregnant rats at 120 mg/kg/day caused significant depression in fetal

body weights. This endpoint was selected as the critical effect. An uncertainty factor of 100 was used to compensate for inter-species extrapolation and for sensitive human populations. The derivation of an inhalation RfD has not yet been verified.

**Reproductive/Developmental Effects** - In rats and mice oral administration of phenol resulted in fetal toxicity (U.S. PHS, 1988). Phenol is not considered a pure teratogen in rats and mice. However, fetal weights may be affected by phenol exposure, as noted above.

## **References**

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Phenol, dated 4/6/92.

U.S. Public Health Service, 1988. Toxicological Profile for Phenol.

## **4-Methylphenol (p-Cresol)**

**Absorption** - The oral and inhalation absorption of 4-methylphenol is assumed because of toxicity resulting from these types of exposures. However, the quantities absorbed have not been determined (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - 4-Methylphenol is classified in Group C (U.S. EPA, 1993). This is based on skin papillomas in mice to which a mixture of chemicals, including 4-methylphenol, was applied (U.S. EPA, 1993).

**Threshold Effects** - Cresol isomers, in general, are highly irritating to skin, mucous membranes, and eyes. Exposure may impair kidney and liver functions and result in CNS effects and cardiovascular problems (Clement, 1985). The subchronic and chronic oral reference doses, both  $5 \times 10^{-3}$  mg/kg/day, are based on the exposure by gavage of rabbits to 4-methylphenol and the resulting hypoactivity, respiratory distress, and death (U.S. EPA, 1994).

**Reproductive/Developmental Effects** - According to the Health Effects Assessment for Cresols (U.S. EPA, 1984), Lysol®, which contains cresol, has been used in several human cases as an abortifacient. Because Lysol® contains other chemical components in addition to cresol, this information does not provide strong evidence of reproductive and developmental toxicity from exposure to cresols.

## **References**

- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- U.S. EPA, 1984. Health Effects Assessment for 4-Methylphenol. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 4-Methylphenol, dated 8/2/93.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual - FY 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303 (94-1).

## **2-Chlorophenol**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - A carcinogenicity assessment is not available on IRIS (U.S. EPA, 1993).

**Threshold Effects** - A NOAEL of 5 mg/kg/day was derived from a subchronic rat drinking water study (U.S. EPA, 1993). There were critical reproductive effects. Rats were bred after being exposed to a range of 0 to 500 ppm of 2-chlorophenol in drinking water for 10 weeks. An increase in the conception rate and in the number of stillborns as well as a decrease in the size of the litters was observed. An uncertainty factor of 1000 was used to account for potential inter-species variability, intra-species extrapolation, and the use of subchronic data. The chronic oral RfD generated from this study is  $5 \times 10^{-3}$  mg/kg/day (U.S. EPA, 1993). No inhalation RfDs have been generated.

**Reproductive/Developmental Effects** - No information available.

## References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; 2-Chlorophenol, dated 7/1/93.

## Pentachlorophenol

**Absorption** - Absorption of pentachlorophenol has been documented as essentially complete, following oral administration in humans. Complete absorption occurs due to the non-polar nature of this compound, and the average half-life of absorption has been calculated to be approximately 1.3 hours, indicating that oral absorption of pentachlorophenol in humans is rapid (U.S. EPA, 1984). Inhalation of pentachlorophenol also results in rapid absorption.

**Distribution** - Analysis of human tissues and fluids revealed that the highest concentrations of pentachlorophenol occur in the liver, kidney, and brain (U.S. PHS, 1987). Lower levels were

also detected in the spleen and body fat. In rats, however, pentachlorophenol did not seem to accumulate following inhalation. Rapid clearance occurred and a high percentage of the compound was recuperated from the urine. In general, the binding of pentachlorophenol to plasma proteins plays an important role in pentachlorophenol distribution.

**Metabolism** - Animal and human studies indicate that pentachlorophenol is not readily metabolized, based on the high concentration of unchanged pentachlorophenol which is excreted upon administration (U.S. PHS, 1987).

**Carcinogenicity** - Based on sufficient evidence of carcinogenicity in animals, pentachlorophenol is classified in Group B2, a probable human carcinogen (U.S. EPA, 1993). Statistically significant increases in the incidences of multiple biologically significant tumor types were found in mice using two different preparations of pentachlorophenol in daily feed administered (U.S. EPA, 1993). In addition, a high incidence of two uncommon tumors was observed with both preparations. This classification is supported by mutagenicity data, which provide some indication that pentachlorophenol may cause chromosomal abnormalities. Human carcinogenic data is inadequate. The oral slope factor for pentachlorophenol developed by the U.S. EPA is  $1.2 \times 10^{-1}$  per mg/kg/day (U.S. EPA, 1993). No inhalation slope factor for pentachlorophenol is available.

**Threshold Effects** - The chronic oral RfD for pentachlorophenol was generated from a NOAEL of 3 mg/kg/day from a study involving oral exposures of rats (U.S. EPA, 1993). Rats were administered 1 of 3 doses in a diet. At 30 mg/kg/day, reduced body weight and fetal toxicity were seen. Pigmentation of the liver and kidneys was observed at exposure levels of 10 mg/kg/day and 30 mg/kg/day. A chronic oral RfD of  $3 \times 10^{-2}$  mg/kg/day was derived by the EPA based on liver and kidney pathology (U.S. EPA, 1993). An oral uncertainty factor of 100 accounts for the expected intra- and inter-species variability in the toxicity of the chemical. An inhalation RfD summary risk assessment for pentachlorophenol is under review by an EPA work group.



**Reproductive/Developmental Effects** - A teratogenicity study was conducted where oral administration of a high dose of pentachlorophenol resulted in delayed skull ossification in rats (U.S. PHS, 1987). In another study, pentachlorophenol fed to rats led to fetotoxic effects as well as maternal toxicity (U.S. EPA, 1984). Research indicates that pentachlorophenol apparently does not cross the placental barrier, so the observed fetotoxicity may be a reflection of maternal toxicity.

## **References**

- U.S. EPA, 1984. Health Effects Assessment for Pentachlorophenol. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Pentachlorophenol, dated 7/1/93.
- U.S. Public Health Service, 1987. Toxicological Profile for Pentachlorophenol.

## **Diethyl phthalate**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Diethyl phthalate is classified in Group D, not classifiable as a human carcinogen (U.S. EPA, 1993). There are no data available in the literature.

**Threshold Effects** - A NOAEL of 750 mg/kg-bw/day was developed from a 16-week rat feeding study (U.S. EPA, 1993). The critical effect was decreased growth rate, food consumption and altered organ weights. The estimated mean intakes were 0 to 3710 mg/kg/day. An uncertainty

factor of 1000 was used to account for extrapolation from subchronic to chronic exposure, inter-species variation, and sensitive human subpopulations. The chronic oral RfD generated from this study is  $8 \times 10^{-1}$  mg/kg/day (U.S. EPA, 1993). No inhalation RfDs have been generated.

**Reproductive/Developmental Effects** - No information available.

## **References**

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Diethylphthalate, dated 2/1/93.

## **Di-n-butyl Phthalate**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Di-n-butyl phthalate is classified in Group D, not classifiable as a human carcinogen due to unavailable data regarding carcinogenicity (U.S. EPA, 1993).

**Threshold Effects** - Based on a chronic oral 52-week study on rats, a chronic oral RfD of  $1 \times 10^{-1}$  mg/kg/day has been established (U.S. EPA, 1993). Rats were fed 125 mg/kg/day of di-n-butyl phthalate in their diet, and increased mortality resulted. The oral RfD is being reconsidered by the RfD work group. An uncertainty factor of 1000 was used.

**Reproductive/Developmental Effects** - No information available.

## References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Di-n-butylphthalate, dated 2/1/93.

### Butylbenzyl phthalate

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Based on an NTP bioassay study resulting in a statistically significant increase in mononuclear cell leukemia in female rats, butylbenzyl phthalate is classified in Group C, as a possible human carcinogen (U.S. EPA, 1993). Studies indicate that butylbenzyl phthalate is not a direct acting mutagen in the reverse mutation assay with *Salmonella typhimurium* or in *Escherichia coli* (U.S. EPA, 1993). A slope factor is not available on IRIS (U.S. EPA, 1993).

**Threshold Effects** - Based on the critical effects of significantly increased liver-to-body weight and liver-to-brain weight ratios from a six month subchronic oral rat study, a chronic oral RfD was set (U.S. EPA, 1993). This level was generated after rats were administered concentrations of either 0, 0.03, 0.09, 0.28, 0.83 or 2.5% butylbenzyl phthalate in the diet for 26 weeks. An uncertainty factor of 1000 was used to compensate for intra-species sensitivity, inter-species variability, and extrapolation from subchronic to chronic levels. The NOAEL of 159 mg/kg/day was used to derive the oral RfD at  $2.0 \times 10^{-1}$  mg/kg/day (U.S. EPA, 1993). No data exist to derive an inhalation RfD.

**Reproductive/Developmental Effects** - No information available.

## References

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Butylbenzyl phthalate, dated 2/1/93.

### Bis(2-Ethylhexyl)phthalate

**Absorption** - Upon oral administration, bis(2-ethylhexyl)phthalate (DEHP) and its principal metabolites are readily absorbed from the gastrointestinal tract in animals. In rats, inhaled bis(2-ethylhexyl)phthalate is absorbed by the lung whereas dermal application to rat skin results in poor absorption of this chemical. No human data are available (U.S. PHS, 1989).

**Distribution** - Absorbed bis(2-ethylhexyl)phthalate is readily distributed to the organs and tissues with the liver being the principal initial repository organ (U.S. PHS, 1989). Clearance is rapid; no apparent accumulation has been observed (U.S. PHS, 1989).

**Metabolism** - Bis(2-ethylhexyl)phthalate is hydrolyzed to its corresponding monoester primary metabolite and subsequently an alcoholic substituent, 2-ethylhexanol, is released (U.S. PHS, 1989). The monoester metabolite and 2-ethylhexanol are quickly oxidized to a variety of more polar products.

**Carcinogenicity** - Based on significant dose-related increases in liver tumor responses in rats and mice, bis(2-ethylhexyl)phthalate is classified in Group B2, a probable human carcinogen (U.S. EPA, 1993). Results from human data are considered inadequate. Bis(2-ethylhexyl)phthalate has mixed results in mutagenicity assays. The oral slope factor of  $1.4 \times 10^{-2}$  per mg/kg/day was generated from an NTP study using male and female rats and mice (U.S. EPA, 1993). The rats were fed diets ranging from 0 to 12,000 mg/kg/day bis(2-ethylhexyl)phthalate for 103 weeks, and the mice were given 0 to 6,000 mg/kg/day in the diet for 103 weeks. No inhalation unit risk has been derived.

**Threshold Effects** - A chronic oral RfD for bis(2-ethylhexyl)phthalate was generated as  $2 \times 10^2$  mg/kg/day from a LOAEL of 19 mg/kg/day in a 1-year guinea pig feeding study (U.S. EPA, 1993). The critical effect was increased relative liver weight in treated females. An uncertainty factor of 1000 was used to compensate for inter-species variation, to protect sensitive human subpopulations, and because the guinea pig exposure was longer than subchronic, but less than lifetime. While the RfD is set on a LOAEL, the effect observed was considered to be minimally adverse, so a higher uncertainty factor was not employed.

**Reproductive/Developmental Effects** - Studies demonstrate that DEHP is a reproductive toxicant in mice and rats. Testicular damage and fertility reduction were observed (U.S. PHS, 1989). No human data regarding reproductive effects via inhalation, ingestion or dermal exposure are available (U.S. PHS, 1989).

#### **References**

U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Bis(2-Ethylhexylphthalate), dated 2/1/93.

U.S. Public Health Service, 1989. Toxicological Profile for Bis(2-Ethylhexylphthalate).

#### **Dibenzofuran**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Dibenzofuran has been classified in Group D because no human and animal data are available (U.S. EPA, 1992). Dibenzofuran is not known to be mutagenic (U.S. EPA, 1992).

**Threshold Effects** - Insufficient data exist to derive inhalation and oral RfDs (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - No information available.

## **References**

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Dibenzofuran, dated 5/1/92.

## **Carbazole**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Carbazole has been classified in Group B2, a probable human carcinogen (U.S. EPA, 1994). An oral slope factor of  $2.0 \times 10^{-2}$  per mg/kg/day was derived from a 96-week dietary study in mice, based on liver tumors (U.S. EPA, 1994). No inhalation unit risk has been determined.

**Threshold Effects** - No data exist to derive inhalation and oral RfDs.

**Reproductive/Developmental Effects** - No information available.

## References

U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY - 1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C., 9200.6-303(94-1).

## Naphthalene

Naphthalene is a lightweight PAH of simple structure: two six-carbon rings sharing a side.

**Absorption** - Although no quantitative data are available, naphthalene is known to be absorbed following ingestion and inhalation based on the resulting toxic effects (U.S. EPA, 1984).

**Distribution** - No information is available.

**Metabolism** - A liver metabolite of naphthalene (1,2-dihydro-, 1,2-dihydroxy-naphthalene) is shown to be related to toxic ocular effects (Klaassen et al., 1986).

**Carcinogenicity** - The carcinogenic classification for naphthalene is Group D; not classifiable as to human carcinogenicity (U.S. EPA, 1994a).

**Threshold Effects** - The site of critical concern for naphthalene is the eye. Naphthalene is associated with cataracts and retina degeneration in laboratory animals. Inhalation exposure caused nausea, headache, and optic and kidney damage in humans and experimental animals (Clement, 1985). A chronic oral RfD for naphthalene is not provided on IRIS or HEAST (U.S. EPA, 1994a; 1994b).

**Reproductive Effects** - Naphthalene metabolites are known to cross the placenta in sufficient amounts to cause fetotoxic effects (U.S. EPA, 1984). Naphthalene retarded cranial ossification and heart development in the offspring of exposed pregnant rats (Clement, 1985).

## References

- Clement Associates, 1985. Chemical, Physical and Biological Properties of Chemicals Present at Hazardous Waste Sites. Prepared for EPA.
- Klaassen, C.D., Amdur, M.O. and J. Doull (eds)., 1986. Casarett and Doull's Toxicology, Third Edition. MacMillan Publishing Company.
- U.S. EPA, 1984. Health Effects Assessment for Naphthalene. Office of Research and Development Cincinnati, Ohio.
- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Naphthalene, dated 9/1/94.
- U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY - 1994. Office of Research and Development - Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303 (94-1).

### 2-Methylnaphthalene

No data on this compound was readily available from EPA resources.

### Fluorene

**Absorption** - Fluorene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism and their toxic and carcinogenic properties.



**Carcinogenicity** - Due to a lack of human data and inadequate data from animal bioassays, fluorene has been classified in Group D (U.S. EPA, 1992).

**Threshold Effects** - Based on a subchronic mouse oral study, a NOAEL of 125 mg/kg/day was determined for fluorene (U.S. EPA, 1992). Mice were exposed to 0, 125, 250 or 500 mg/kg/day fluorene suspended in corn oil by gavage for 13 weeks. Critical effects observed were a significant decrease in red blood cell count, packed cell volume and hemoglobin concentration (U.S. EPA, 1992). An uncertainty factor of 3000 was derived to compensate for use of a subchronic study for chronic RfD derivation, inter- and intra-species variability, lack of adequate data in a second species and lack of reproductive or developmental data. The chronic oral RfD derived from this study is  $4 \times 10^{-2}$  mg/kg/day (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - No information available.

## References

- U.S. EPA, 1984. Health Effects Assessment for Fluorene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Fluorene, dated 1/22/92.

## Acenaphthene

**Absorption** - Acenaphthene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore their toxic and carcinogenic properties may also be altered.

**Carcinogenicity** - Acenaphthene is unclassified with respect to carcinogenicity (U.S. EPA, 1993).

**Threshold Effects** - Based on a mouse oral subchronic study, a NOAEL of 175 mg/kg/day was derived for acenaphthene. Four groups of mice were fed by gavage daily with 0, 175, 350 or 700 mg/kg/day acenaphthene for 90 days. Critical effects observed included liver weight changes accompanied by microscopic alterations and increases in cholesterol levels. An uncertainty factor of 3000 accounts for inter- and intra-species variability, the use of a subchronic study for chronic RfD derivation, lack of adequate data in a second species, and lack of reproductive or developmental data. The chronic oral RfD derived is  $6 \times 10^{-2}$  mg/kg/day (U.S. EPA, 1993). No inhalation data are available to determine an inhalation RfD.

**Reproductive/Developmental Effects** - No information available.

## References

- U.S. EPA, 1984. Health Effects Assessment for Acenaphthene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Acenaphthene, dated 5/3/93.

## Anthracene

**Absorption** - Anthracene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore their toxic and carcinogenic properties may also be altered.

**Carcinogenicity** - Anthracene has been classified in Group D, not classifiable as to human carcinogenicity, due to lack of human data and inadequate data from animal bioassays (U.S. EPA, 1994).

**Threshold Effects** - A chronic oral RfD of  $3 \times 10^{-1}$  mg/kg/day was derived for anthracene based on a subchronic toxicity study in mice (U.S. EPA, 1994). Groups of male and female mice were exposed to anthracene by gavage at doses of 0, 250, 500 and 1000 mg/kg/day for at least 90 days. No treatment-related effects were noted. The NOEL is the highest dose tested (1000 mg/kg/day). An uncertainty factor of 3000 was used, to account for inter-species extrapolation, intra-species variability, use of a subchronic study for the chronic RfD derivation, lack of reproductive or developmental data, and lack of adequate toxicity data in a second species (U.S. EPA, 1994). No inhalation RfD has been generated.

**Reproductive/Developmental Effects** - No information available.

## References

- U.S. EPA, 1984. Health Effects Assessment for Anthracene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Anthracene, dated 9/1/94.

## **Phenanthrene**

**Absorption** - Phenanthrene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the gastrointestinal tract after ingestion or from the lungs after inhalation, primarily by passive diffusion (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Phenanthrene is classified in Group D, based on no human data and inadequate data in animal studies (U.S. EPA, 1994).

**Threshold Effects** - Phenanthrene is known to cause phototoxic reactions when dermally applied to skin (Klaassen et al., 1986). The oral LD<sub>50</sub> for mice is 700 mg/kg. A chronic oral RfD is currently not available for phenanthrene (U.S. EPA, 1994).

**Reproductive/Developmental Effects** - No information available.

## **References**

- Klaassen, C.D., Amdur, M.O. and J. Doull (eds), 1986. Casarett and Doull's Toxicology. Third Edition, 1986. MacMillan Publishing Company, U.S.A.
- U.S. EPA, 1984. Health Effects Assessment for PAHs. Office of Research and Development, Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Phenanthrene, dated 9/1/94.

## **Pyrene**

**Absorption** - Oral administration of an aqueous suspension of pyrene was reported as poorly absorbed from the gut of male rats in one study (U.S. EPA, 1984). However, the same study concluded that rapid pulmonary absorption of a pyrene aerosol (300-500 ug/l of air) is achieved via inhalation by male rats.

**Distribution** - Widespread tissue distribution occurs upon inhalation of pyrene (U.S. EPA, 1984).

**Metabolism** - Pyrene is a PAH and, in general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore, their toxic and carcinogenic properties may also be altered.

**Carcinogenicity** - Pyrene is classified in Group D due to lack of human data, inadequate data from animal bioassays, and mixed results from mutagenicity data (U.S. EPA, 1994).

**Threshold Effects** - Based on a study involving the subchronic exposure of mice, a NOAEL of 75 mg/kg/day for pyrene was established (U.S. EPA, 1994). Critical effects observed were kidney effects, including nephropathy and reduced kidney weight. An uncertainty factor of 3000 was established to reflect potential intra- and inter-species variability, the use of a subchronic study for chronic RfD derivation, the lack of toxicity studies in a second species, and lack of developmental or reproductive studies. The chronic oral RfD was determined to be  $3 \times 10^{-2}$  mg/kg/day based on the NOAEL and the uncertainty factor (U.S. EPA, 1994). No inhalation RfD has been derived.

**Reproductive/Developmental Effects** - No information available.

## References

- U.S. EPA, 1984. Health Effects Assessment for Pyrene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Pyrene, dated 9/1/94.

## Fluoranthene

**Absorption** - Fluoranthene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism; therefore, their toxic and carcinogenic properties may also be altered.

**Carcinogenicity** - Fluoranthene is classified in Group D based on lack of human data, deficient animal data, and ambiguous mutagenicity data (U.S. EPA, 1994).

**Threshold Effects** - Based on a 13-week, subchronic study involving the oral exposure of mice, a NOAEL of 125 mg/kg/day was established for fluoranthene (U.S. EPA, 1994). Critical effects observed were increased liver weight, nephropathy, and hematological alterations. An uncertainty factor of 3000 was used to compensate for potential inter-species differences, intra-species variability, use of a subchronic study to generate a chronic RfD, lack of supporting reproductive or developmental toxicity data, and lack of toxicity data in a second species. The chronic oral RfD established from this study is  $4 \times 10^{-2}$  mg/kg/day (U.S. EPA, 1994). No inhalation RfD has been generated.

**Reproductive/Developmental Effects** - No information available.

## **References**

- U.S. EPA, 1984. Health Effects Assessment for Fluoranthene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Fluoranthene, dated 9/1/94.

## **Benzo(a)anthracene**

**Absorption** - Benzo(a)anthracene is readily absorbed by oral and dermal routes, as evidenced in rat and mouse studies. In one study, levels of this PAH compound reached a maximum in the blood, liver and brain only 1 to 2 hours after oral administration (U.S. PHS, 1990). Quantitative information on absorption via the respiratory tract is not available, but uptake has been determined to be dependent on the blood perfusion rate of the affected tissue.

**Distribution** - Due to rapid absorption via oral exposure, this PAH is rapidly distributed among several body tissues including liver, blood, and brain, and slowly distributed in mammary and adipose tissues, where it tends to accumulate (U.S. PHS, 1990).

**Metabolism** - Metabolism in animals and humans is very similar to the benzo(a)pyrene biotransformation pathways. Primary biotransformations include the oxidation of the aromatic nucleus to form arene oxides, dihydrodiols, and diol epoxides (U.S. PHS, 1990). These resulting intermediates are responsible for the toxic action and carcinogenic effects of benzo(a)anthracene. These metabolites are then excreted predominantly in the feces, as is characteristic of all PAHs (U.S. PHS, 1990).

**Carcinogenicity** - Benzo(a)anthracene has been classified in Group B2 as a possible human carcinogen (U.S. EPA, 1994). Although human data are lacking, there are sufficient data from

animal bioassays to classify benzo(a)anthracene in Group B2. Tumors were produced in mice exposed by gavage; intraperitoneal, subcutaneous or intramuscular injections; and topical application. Mutations in bacteria and in mammalian cells have been produced. No slope factor is provided for benzo(a)anthracene (U.S. EPA, 1994).

**Threshold Effects** - An oral RfD has not been established by EPA for benzo(a)anthracene.

**Reproductive/Developmental Effects** - No information was located.

## **References**

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benz(a)anthracene, dated 9/1/94.

U.S. Public Health Service, 1990. Toxicological Profile for Benz(a)anthracene.

## **Chrysene**

**Absorption** - Absorption of chrysene occurs principally via the gastrointestinal tract and also through the skin. No quantitative data on the absorption of chrysene by inhalation exists (U.S. PHS, 1990).

**Distribution** - One study using rats found that orally absorbed chrysene is distributed to adipose, mammary, brain, liver, and blood tissues, but preferentially accumulates in the adipose and mammary tissues (U.S. PHS, 1990).

**Metabolism** - Metabolism of chrysene in humans and animals parallels the biotransformation pathways described for benzo(a)pyrene (U.S. PHS, 1990). Chrysene is metabolized to reactive derivatives which are believed to be responsible for its carcinogenic nature.



**Carcinogenicity** - Chrysene has been classified in Group B2, as a probable human carcinogen (U.S. EPA, 1994). Although no human data are available, sufficient data from animal bioassays exist to establish this classification (U.S. EPA, 1994). Chrysene produced liver and lung tumors and malignant lymphoma in mice after intraperitoneal injection and skin carcinomas in mice following dermal exposure. Chromosomal abnormalities in hamster and mouse germ cells were produced after gavage exposure to chrysene; also, chrysene produced positive responses in bacterial gene mutation assays (U.S. EPA, 1994). No slope factor has been established for chrysene (U.S. EPA, 1994).

**Threshold Effects** - An oral RfD has not been established by EPA for chrysene.

**Reproductive/Developmental Effects** - No information available.

## **References**

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Chrysene, dated 3/2/94.

U.S. Public Health Service, 1990. Toxicological Profile for Chrysene.

## **Benzo(b)fluoranthene**

**Absorption** - Absorption of benzo(b)fluoranthene through the lungs and skin is expected to be similar to that of benzo(a)pyrene, which is readily absorbed by both these routes (U.S. PHS, 1990).

**Distribution** - No information available.

**Metabolism** - The pathways of benzo(b)fluoranthene metabolism in the liver have been extensively investigated. Insoluble metabolites can be classified as dihydrodiols and phenols.

Subsequent hepato-biliary excretion results in elimination of dihydrodiol and phenol and glutathione conjugates in the feces (U.S. PHS, 1990).

**Carcinogenicity** - Benzo(b)fluoranthene is classified in Group B2, as a probable human carcinogen (U.S. EPA, 1994). Although no human data are available, sufficient data from animal bioassays exist to establish this classification. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal or subcutaneous injection, and skin painting. No slope factor has been established for benzo(b)fluoranthene (U.S. EPA, 1994).

**Threshold Effects** - An oral RfD has not been established by EPA for benzo(b)fluoranthene.

**Reproductive/Developmental Effects** - No information available.

## **References**

- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzo(b)fluoranthene, dated 3/2/94.
- U.S. Public Health Service, 1990. Toxicological Profile for Benzo(b)fluoranthene.

## **Benzo(a)pyrene**

**Absorption** - Benzo(a)pyrene is readily absorbed through the respiratory tract, the gastrointestinal tract, and the skin (U.S. PHS, 1987). This information is primarily based on data obtained from animal studies.

**Distribution** - After absorption, benzo(a)pyrene is rapidly distributed to and absorbed by several tissues, including the esophagus, intestines, kidneys, liver, lungs and stomach (U.S. PHS, 1987). This information is based on data from inhalation studies conducted with rats.

**Metabolism** - The pathways of benzo(a)pyrene metabolism are well described, based on results of human and animal studies. This PAH is metabolized to varying degrees by several tissues including the kidneys, liver, and lungs, as well as other tissues of the respiratory and gastrointestinal tracts. The first metabolic phase results in the formation of arene oxides and phenols. Subsequent reactions produce quinones, dihydrodiols, phenol-diols, and diol epoxides, which may hydrolyze to tetrols. These compounds may then form conjugates with glutathione, sulfate, or glucuronic acids to form Phase III metabolites, which are eliminated in the feces following hepato-biliary excretion (U.S. PHS, 1987).

**Carcinogenicity** - Benzo(a)pyrene has been classified in Group B2, as a possible human carcinogen (U.S. EPA, 1994). Studies in rodents and other species demonstrate benzo(a)pyrene to be carcinogenic following exposure by oral, intratracheal, inhalation, and dermal routes. Oral administration of benzo(a)pyrene has induced stomach tumors, lung tumors, and leukemia in experimental animals, while inhalation exposures have induced nasal, tracheal, pharyngeal, and upper digestive tumors. Dermal administration of benzo(a)pyrene has induced skin tumors. Benzo(a)pyrene has produced positive results in several in vitro bacterial and mammalian genetic toxicology assays (U.S. EPA, 1994).

Human data specifically linking benzo(a)pyrene to a carcinogenic effect are lacking. Lung cancer has been shown to be induced in humans by various mixtures of polycyclic aromatic hydrocarbons known to contain benzo(a)pyrene. It is not possible, however, to conclude from this information that benzo(a)pyrene is the responsible agent. The current oral slope factor for benzo(a)pyrene is 7.3 per mg/kg/day (U.S. EPA, 1994) and was calculated as the geometrical mean of a range of slope factors between 4.5 and 11.7 per mg/kg/day.

**Threshold Effects** - There is no EPA approved chronic oral RfD for benzo(a)pyrene.

**Reproductive/Developmental Effects** - No data are available on the reproductive and developmental effects of benzo(a)pyrene on humans. However, studies with mice involving oral exposures indicate that decreased fertility and progeny sterility may constitute reproductive

effects expected in humans (U.S. PHS, 1987). Potential developmental effects include low birth weight, stillbirth, resorption, and malformations (U.S. PHS, 1987).

## **References**

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzo(a)pyrene, dated 7/6/94.

U.S. Public Health Service, 1987. Toxicological Profile for Benzo(a)pyrene.

## **Benzo(k)fluoranthene**

**Absorption** - Benzo(k)fluoranthene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore their toxic and carcinogenic properties may also be altered.

**Carcinogenicity** - Benzo(k)fluoranthene has been classified in Group B2, as a probable human carcinogen, due to sufficient data from animal bioassays (U.S. EPA, 1994). Although there are no human data that specifically link exposure to benzo(k)fluoranthene to human cancers, benzo(k)fluoranthene is a component of mixtures that have been associated with human cancer (U.S. EPA, 1994). No slope factor has been established for benzo(k)fluoranthene (U.S. EPA, 1994).

**Threshold Effects** - No chronic oral RfD has been established by EPA.

**Reproductive/Developmental Effects** - No information available.

## **References**

U.S. EPA, 1984. Health Effects Assessment for Benzo(k)fluoranthene. Office of Research and Development. Cincinnati, Ohio.

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Benzo(k)fluoranthene, dated 3/2/94.

## **Indeno(1,2,3-cd)pyrene**

**Absorption** - No information available.

**Distribution** - No information available.

**Metabolism** - No information available.

**Carcinogenicity** - Indeno(1,2,3-cd)pyrene is classified in Group B2, as a probable human carcinogen, based on sufficient data from animal bioassays (U.S. EPA, 1994). No slope factor has been established for indeno(1,2,3-cd)pyrene (U.S. EPA, 1994).

**Threshold Effects** - A chronic oral RfD has not been established by EPA for indeno(1,2,3-cd)pyrene.

**Reproductive/Developmental Effects** - No information available.

## **References**

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Indeno(1,2,3-cd)pyrene, dated 3/2/94.

### **Benzo(g,h,i)perylene**

**Absorption** - Benzo(g,h,i)perylene, as a PAH, is highly lipid soluble and is expected to be readily absorbed from the GI tract (U.S. EPA, 1984).

**Distribution** - No information available.

**Metabolism** - In general, PAH metabolism by the microsomal mixed function oxidase enzyme system yields several types of reactive and potentially carcinogenic intermediates (U.S. EPA, 1984). Chemicals known to induce or inhibit this enzyme system subsequently alter the patterns of PAH metabolism, therefore, their toxic and carcinogenic properties may also be altered.

**Carcinogenicity** - Benzo(g,h,i)perylene has been classified in Group D, not classifiable as to human carcinogenicity (U.S. EPA, 1992). No human data are available, and animal data from animal bioassays are inadequate to establish a positive classification as a carcinogen.

**Threshold Effects** - A chronic oral RfD has not been established by EPA for benzo(g,h,i)perylene.

**Reproductive/Developmental Effects** - No information available.

### **References**

- U.S. EPA, 1984. Health Effects Assessment for Benzo(g,h,i)perylene. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Benzo(g,h,i)perylene, dated 1/22/92.

### **Dibenzo(a,h)anthracene**

**Absorption** - Animal studies indicate that dibenzo(a,h)anthracene is absorbed by the oral route of exposure, while dermal absorption occurs very slowly. Inhalation absorption has not been investigated (U.S. PHS, 1990).

**Distribution** - Absorbed dibenzo(a,h)anthracene is generally distributed to several tissues with relative uptake dependent on the blood perfusion rate of the tissue. Initially, concentrations are higher in the liver and kidney. It is persistent in the ovaries and adipose tissue (U.S. PHS, 1990).

**Metabolism** - Dibenzo(a,h)anthracene is metabolized more slowly than PAHs of lower molecular weight (U.S. PHS, 1990). The principal metabolic intermediates formed include arene oxides, phenols, dihydrodiols, and a dio-epoxide. Dibenzo(a,h)anthracene is primarily excreted in the feces (U.S. PHS, 1990).

**Carcinogenicity** - Dibenzo(a,h)anthracene has been classified in Group B2, a probable human carcinogen, based on sufficient data from animal bioassays (U.S. EPA, 1994). Carcinomas have been observed in mice following oral or dermal exposure and injection site tumors have been observed following subcutaneous or intramuscular administration of dibenzo(a,h)anthracene. DNA damage and gene mutations in bacteria as well as gene mutations and transformation in several types of mammalian cell cultures have been induced by dibenzo(a,h)anthracene. No slope factor has been established (U.S. EPA, 1994).

**Threshold Effects** - No chronic oral RfD has been established by EPA for dibenzo(a,h)anthracene.

**Reproductive/Developmental Effects** - Data regarding reproductive or developmental effects in humans or experimental animals could not be located in the available literature.

## References

- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Dibenzo(a,h)anthracene, dated 3/2/94.
- U.S. Public Health Service, 1990. Toxicological Profile for Dibenzo(a,h)anthracene.

### Lindane (gamma BHC) (Gamma-Hexachloro cyclohexane)

**Absorption** - The unusually high solubility of Lindane in water, compared with other organochlorine pesticides, contributes to its rapid absorption. Lindane is readily absorbed by the body following inhalation, oral, and dermal exposures. High blood concentrations have been observed following a number of acute poisoning cases (U.S. PHS, 1989). The average absorption of Lindane following administered doses in feed was 99.4% (U.S. PHS, 1989). The ready absorption of Lindane through human skin has been demonstrated with topical lotion applications. Studies involving topical application of Lindane to the forearm indicate rapid absorption of at least 97% of the applied dose with maximum absorption occurring 2 to 3 days after application (U.S. PHS, 1989).

**Distribution** - Following inhalation exposure to Lindane in the workplace, air concentrations of 0.004 to 0.15 mg/m<sup>3</sup> were associated with blood serum levels in workers of 0.7 ug/L. HCH isomers have also been detected in adipose tissue following inhalation exposure (U.S. PHS, 1989). Studies of human poisonings indicate that Lindane is partly distributed to the central nervous system following both oral and dermal exposures. Animal studies have shown that Lindane is primarily stored in the fat tissue of rats following oral administration (U.S. PHS, 1989).

**Metabolism** - The metabolism and subsequent detoxification of Lindane appears to be dependent on the P450 oxidative system. The metabolism in rats and mice is similar to that in humans. Researchers have determined that chlorophenols and chlorbenzenes are the primary metabolites



of Lindane and are excreted primarily in the urine, and also in milk and semen (U.S. PHS, 1989).

**Carcinogenicity** - Lindane is classified in Group B2-C (U.S. EPA, 1994), indicating that the evidence supports classification of Lindane either as a probable or a possible human carcinogen. The oral slope factor is 1.3 per mg/kg/day (U.S. EPA, 1994). The oral slope factor is based on the occurrence of liver tumors in mice following exposure to Lindane in the diet.

**Threshold Effects** - Based on a chronic oral study in rats, a chronic oral RfD of  $3 \times 10^{-4}$  mg/kg/day was derived (U.S. EPA, 1992). Rats were administered 0.29 to 0.33 mg/kg/day of Lindane in their diet. The RfD is based on a critical effect of liver and kidney toxicity. An uncertainty factor of 1,000 was used (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - No studies were located regarding reproductive or developmental effects in humans following oral exposure to Lindane. Lindane has not been reported to cause developmental effects in animals (U.S. PHS, 1989). Oral exposure to Lindane has been reported to be associated with adverse reproductive effects in rats which include increased weight and atrophy of the ovary and uterus in females and degeneration of seminiferous tubules and disruption of spermatogenesis in males (U.S. PHS, 1989).

## References

- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Lindane, dated 7/6/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development - Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303 (94-1).
- U.S. PHS, 1989. Draft Toxicological Profile for Gamma-Hexachlorocyclohexane.

## **Endosulfan**

Endosulfan is a pesticide used to control insects on grains, fruits, vegetables, tobacco, and cotton. Endosulfan exists as the alpha and beta isomeric forms. Endosulfan rapidly breaks down in water and air, but may be more persistent in soils.

**Absorption** - Indirect evidence from occupational poisonings suggests that endosulfan may be absorbed through the lungs. Animal studies with radiolabelled endosulfan indicate that close to 90% of an oral dose of endosulfan may be absorbed. There is also evidence from animal studies that endosulfan may be absorbed dermally (U.S. PHS, 1991).

**Distribution** - Following acute oral exposures to endosulfan, isomers of the parent compound and the metabolite, endosulfan sulfate, were found in blood, liver, kidney, brain, and fat. Gavage and feeding studies indicate that endosulfan is initially distributed to fatty tissues, with an accumulation in the kidneys after prolonged exposure (U.S. PHS, 1991).

**Metabolism and Excretion** - Endosulfan exists as two isomeric forms which are quickly metabolized in the liver to yield endosulfan sulfate and endosulfan diol. Endosulfan sulfate is believed to have toxic properties similar to the parent compound. Endosulfan sulfate and endosulfan diol can be further metabolized to endosulfan lactone, hydroxyether, and ether. Endosulfan may be excreted as both the parent compound and metabolites in feces and urine. Small doses may be completely eliminated within several days. There is some evidence that endosulfan may induce Cytochrome P-450 enzyme activity (U.S. PHS, 1991).

**Carcinogenicity** - There is no evidence associating endosulfan with cancers in humans. Chronic studies in which endosulfan was administered to mice and rats have provided either negative or inconclusive results regarding carcinogenic activity. However, endosulfan has produced both positive and negative results in in vitro mutagenicity tests (U.S. PHS, 1991). A carcinogenic classification for endosulfan has not been established by EPA.

**Threshold Effects** - Relatively large ingested doses of endosulfan have been fatal to both animals and humans. In animal studies, changes in liver function appeared to be associated with enzyme induction and may interfere with oxidative phosphorylation. Studies with rats indicate that humoral and cellular immune responses were depressed by oral doses of endosulfan that did not produce any other signs of toxicity. The primary target organ for endosulfan is the nervous system. Acute ingestion of large doses of endosulfan may interfere with various neurotransmitters in the brain and peripheral nervous system resulting in hyperactivity, tumors, decreased respiration, salivation, and convulsions (U.S. PHS, 1991). The U.S. EPA has developed a chronic oral RfD for endosulfan of  $6 \times 10^{-3}$  mg/kg/day (U.S. EPA, 1994); decreased weight gain, kidney effects, and aneurysms are listed as the critical effects.

**Reproductive/Developmental Effects** - Feeding studies in rats suggest that endosulfan produces maternal and fetal toxicity at 5 mg endosulfan/kg/day and doses of 0.66 mg endosulfan/kg/day were teratogenic. Neonatal rats treated with 1 mg endosulfan/kg/day for 5 weeks displayed behavioral abnormalities. Although limited reproductive studies with rodents have been negative, adverse effects on reproductive organs have been reported in male rabbits and female rats (U.S. PHS, 1991).

## **References**

- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development, Office of Emergency and Remedial Response, Washington, D.C., 9200.6-303(94-1).
- U.S. Public Health Service (PHS), 1991. Draft Toxicological Profile for Endosulfan, Endosulfan Alpha, Endosulfan Beta, Endosulfan Sulfate.

## **DDT**

DDT (specifically, 4,4'-dichlorodiphenyltrichloroethane, also known as 4,4'-DDT or p,p'-DDT) is a solid. Technical DDT is generally a mixture of 4,4'-DDT, 4,4'-DDD, and traces of other

materials. DDD and DDE are metabolites or degradation products that are often identified as environmental contaminants.

DDT is the best known of all the synthetic insecticides. This compound was synthesized in 1874. Its insecticidal effectiveness was discovered in 1939 and it was patented in 1942. During World War II, DDT was directly applied to humans for the control of lice and other insects. It was one of the most widely used agricultural insecticides in the United States and other countries from 1946 to 1972 (Klaassen et al., 1986).

**Distribution** - Chronic exposures to DDT, DDD and DDE in humans lead to accumulation of the chemical in fatty tissues. DDT's location of primary toxic action is the sensory, motor nerve fibers and the motor cortex (Klaassen et al., 1986).

**Metabolism** - Metabolites of DDT include 4,4'-DDE and 2,4'-DDD. DDT isomers and metabolites are often found together and have similar properties (Clement Associates, 1985).

**Carcinogenicity** - There is evidence of carcinogenicity in animals with exposures to DDT. Exposures to DDT and its metabolites have lead to liver tumors in mice (U.S. EPA, 1984). Exposures to DDT have also resulted in hepatomas in rats and lymphomas and lung cancers in mice. DDT is classified in Group B2, probable human carcinogen, by the U.S. EPA (U.S. EPA, 1992). EPA has derived an oral slope factor of 0.34 per mg/kg/day and an inhalation unit risk of  $9.7 \times 10^{-5}$  per  $\mu\text{g}/\text{m}^3$  (U.S. EPA, 1992).

**Threshold Effects** - While DDT is classified as a neuropoison, no unequivocal reports of fatal human poisoning have been recorded despite widespread use of the substance for 30 to 40 years (Klaassen et al., 1986). A dose of 200 mg/kg of DDT has been determined to be highly dangerous though not fatal to humans (Sax, 1987).

Most toxicological data are based on oral exposures. Acute oral exposures can lead to symptoms of burning or prickling sensations of the tongue, lips and face, apprehension, irritability,

dizziness and tremors (Klaassen et al., 1986). Chronic oral exposures resulted in liver lesions at all doses tested, the lowest of which was 10 ppm in food or 0.5 mg/kg/day. Additional animal studies showed increased incidence of tumors and increased mortality of offspring in a six generation study with an exposure of 100 ppm (13 mg/kg/day).

DDT and its metabolites are compounds with a capacity to bioconcentrate, typically in the adipose tissues of most animals. Toxic doses produce vomiting, muscle weakness, disturbance of equilibrium, and finally chronic or asphyxial convulsions, followed by death from respiratory failure or ventricular fibrillation (Clayton and Clayton, 1982). The chronic oral RfD of  $5.0 \times 10^{-4}$  mg/kg/day was derived from a study of rats fed commercial grade DDT, where hepatocellular hypertrophy was observed at some doses, and a NOEL was shown to be 0.05 mg/kg/day (U.S. EPA, 1992). Liver lesions were cited as the critical effect.

**Reproductive Effects** - Oral exposures of 2.5 mg/kg/day of DDT ingested by pregnant mice proved embryotoxic and fetotoxic (U.S. EPA, 1984). DDT has consistently caused a decrease in the reproductive capacity of organisms tested.

## References

- Clayton and Clayton, 1982. *Patty's Industrial Hygiene and Toxicology*. Volume IIC - Toxicology. Third Revised Edition.
- Clement Associates, Inc., 1985. *Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites*. Prepared for U.S. EPA.
- Klaassen, C.D., Amdur, M.O. and J. Doull (eds.), 1986. *Casarett and Doull's Toxicology*, Third Edition. MacMillan Publishing Company, U.S.A.
- Sax, N.I., R.J. Lewis Sr., 1987. *Hazardous Chemicals Desk Reference*. New York.
- U.S. EPA, 1984. *Health Effects Assessment for DDT*. Office of Research and Development, Cincinnati, Ohio.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; DDT, dated 2/12/92.

## **Methoxychlor**

**Absorption** - Although not quantified, methoxychlor is known to be absorbed via ingestion and dermal contact based on resulting toxic effects. Depending on routes of exposure, anywhere from 60 to 98 percent for an administered dose may be excreted within 24 hours (U.S. EPA, 1987).

**Distribution** - Studies indicate that after being absorbed, methoxychlor quickly moves to the liver, but it is not readily accumulated in the liver, fat, brain, or heart (U.S. EPA, 1987).

**Metabolism** - When female swiss mice were orally dosed with methoxychlor, the major metabolites detected were the monophenol and bisphenol of methoxychlor. In vitro studies of methoxychlor metabolism detected formaldehyde in addition to the monophenol and bisphenol metabolites (U.S. EPA, 1987).

**Carcinogenicity** - Methoxychlor is classified in Group D, not classified as to human carcinogenicity (U.S. EPA, 1993).

**Threshold Effects** - The oral RfD derived for methoxychlor is  $5 \times 10^{-3}$  mg/kg/day (U.S. EPA, 1993). This RfD is based on a NOAEL of 5.01 mg/kg/day, fed to female rats during gestation. The critical effect listed is excessive loss of litters (U.S. EPA, 1993). This same RfD value is given for subchronic exposures, but no information is available on inhalation RfDs.

**Reproductive/Developmental Effects** - No evidence is available for reproductive effects. Fetotoxicity was, however, the critical effect used to establish the RfD (U.S. EPA, 1993).

## References

- U.S. EPA, 1987. Health Advisories for the Pesticides. Office of Drinking Water, Washington, D.C.
- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Methoxychlor, dated 12/1/93.

## Chlordane

**Absorption** - Chlordane may enter the body through the skin, lungs, or gastrointestinal tract. Excretion via urine and feces is limited. Uptake through the skin and GI tract is facilitated if the chlordane is dissolved in an oily substance. Absorption following inhalation is rapid (U.S. PHS, 1989).

**Distribution** - Chlordane is distributed throughout the body largely to organs, such as the brain and liver, and to fat tissue. However, distribution to the liver and kidneys has been shown to be more rapid than to fat (U.S. PHS, 1989).

**Metabolism** - The following metabolites were found, in decreasing order, during an assay using a human liver microsome preparation: chlordane chlorohydrin, monohydroxylated dihydrochlordane, oxychlordane, and a number of other chlor-, hydroxy-, and epoxy-chlordenes (U.S. PHS, 1989).

**Carcinogenicity** - Based on increased liver cancer in male and female mice and the structural similarities between chlordane and other liver carcinogens, chlordane is classified B2, as a probable human carcinogen (U.S. EPA, 1993). Human data do not show a statistically significant increase in cancer mortality. Chlordane has had mixed results in mutagenicity assays. The oral slope factor of 1.3 per mg/kg/day was derived using the geometric means from the four mouse data sets in which liver cancer was the predominant result (U.S. EPA, 1993). One study by Velsicol Chemical Corporation involved the feeding exposure to male and female CD-1 mice

where concentrations ranged from 0 to 50 ppm. The NCI feeding study used B6C3F1 male and female mice with doses ranging from 29.9 to 63.8 ppm. The inhalation slope factor, 1.3 per mg/kg/day, or  $3.7 \times 10^{-4}$  per  $\mu\text{g}/\text{m}^3$ , was derived from the oral slope factor and is not considered valid above  $30 \mu\text{g}/\text{m}^3$  (U.S. EPA, 1993).

**Threshold Effects** - The target organs for chlordane once it has entered the body are the central nervous system (CNS), the digestive system, and liver. The chronic oral RfD for chlordane was generated from the NOEL of 0.055 mg/kg/day in a 30 month rat feeding study (U.S. EPA, 1993). The critical effect was liver hypertrophy in female rats. Doses ranged from 0.045 to 1.409 mg/kg/day. An uncertainty factor of 1000 was used to compensate for inter- and intra-species differences as well as inadequate reproductive data (U.S. EPA, 1993). The chronic oral RfD generated is  $6 \times 10^{-5}$  mg/kg/day. No inhalation RfDs have been generated.

**Reproduction Effects** - Results from studies on the reproductive toxicity of chlordane show mixed results. There are no data for humans. Some studies indicate testicular toxicity, while others indicate none (U.S. PHS, 1989).

## **References**

- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Chlordane, dated 7/1/93.
- U.S. PHS, 1989. Draft Toxicological Profile for Chlordane.

## **Polychlorinated Biphenyls (PCBs)**

**Absorption** - PCBs are readily absorbed via inhalation and are also absorbed via ingestion and dermal contact. This is illustrated by blood PCB levels and toxic effects from various routes of exposure (U.S. PHS, 1987).



**Distribution** - Studies indicate that PCB distribution occurs in a two-fold manner. First, PCBs move from the blood to the liver and muscles. Much of this PCB is then stored in fat tissue where it remains for long periods of time (U.S. PHS, 1987).

**Metabolism** - Phenolic compounds are the primary products of PCB metabolism although sulfur-containing metabolites, trans-dihydrodiols, polyhydroxylated PCBs, and methy ether derivatives have also been identified. As the chlorination increases on both phenyl rings, the rate of metabolism decreases. A large amount of variation has been found in the metabolism of different PCB isomers and in different species (U.S. PHS, 1987).

**Carcinogenicity** - PCBs are classified as B2, probable human carcinogens (U.S. EPA, 1994). Although human data are inadequate, liver cancer resulted in three strains of rats and two strains of mice. The oral slope factor, 7.7 per mg/kg/day, is based on a study in which Sprague-Dawley rats were fed a diet including Aroclor 1260 for 24 months (U.S. EPA, 1994). Surviving females showed a 91 percent incidence of liver cancer. No inhalation slope factor has been generated (U.S. EPA, 1994).

**Threshold Effects** - PCB exposure can result in liver toxicity as is evident from both human and animal exposures including rats, mice, guinea pigs, rabbits, dogs, and monkeys. Some liver effects seen are enzyme induction, liver enlargement, fat deposition, and necrosis (U.S. PHS, 1987). RfDs are becoming available from EPA for specific Aroclors. No chronic oral RfD is available for PCBs as a group or specifically Aroclor 1260 (U.S. EPA, 1994).

**Reproductive/Developmental Effects** - A study on mink resulted in total reproductive inhibition at a diet of 15 mg/kg/day. Rats have exhibited fetal mortality, reduced litter size, and lengthened menstrual cycles (U.S. PHS, 1987).

## References

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Polychlorinated Biphenyls (PCBs), dated 6/1/94.

U.S. Public Health Service, 1987. Toxicological Profile for PCBs.

## Aluminum

**Absorption** - Occupational studies regarding aluminum absorption in humans determined that following a 1-day exposure (8 hour work shift) to a time weight concentration of 2.4 mg/m<sup>3</sup> aluminum, aluminum levels rapidly increased in the urine (U.S. PHS, 1990). Human and animal studies indicate that absorption readily occurs following inhalation and ingestion exposure to aluminum. However, absorption via the oral route is very dependent on its chemical form.

**Distribution** - Aluminum distribution normally occurs in human body tissues and the total body burden in healthy human subjects ranges from 30 to 50 mg (U.S. PHS, 1990). Of the total body burden, about one-half is in the skeleton and approximately one-fourth is in the lungs (U.S. PHS, 1990). Evidence indicates that, with an increase in age, aluminum concentrations increase in the lungs, liver, kidneys, and brain tissue of humans.

**Metabolism** - Aluminum is an element; therefore, it cannot be destroyed in the body. Aluminum is found in four different forms in the body: as a free ion, as a low molecular weight complex, as a reversible macromolecular complex and as an irreversible macromolecular complex (U.S. PHS, 1990).

**Carcinogenicity** - Data are inadequate for a carcinogenic assessment (U.S. EPA, 1994).

**Threshold Effects** - No chronic oral RfD has been established by EPA for aluminum (U.S. EPA, 1994). Studies indicate that in human infants, excessive aluminum accumulation and

encephalopathy may occur, especially in premature infants with reduced renal function given dialysis with aluminum-contaminated intravenous fluid (U.S. PHS, 1990). Bone disease has been reported in those infants with renal failure who were treated with aluminum hydroxide.

**Reproductive/Developmental Effects** - There is no evidence from several studies that aluminum alters human or animal reproductive capabilities.

## **References**

U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Aluminum, dated 9/1/94.

U.S. Public Health Service, 1990. Toxicological Profile for Aluminum.

## **Arsenic**

**Absorption** - Soluble inorganic arsenic compounds are extensively absorbed by humans and other animals, following ingestion. Less soluble compounds are less readily absorbed. Organic arsenic compounds have various absorption characteristics. Absorption of inhaled arsenic compounds also depends on the chemical form and on particle size (U.S. PHS, 1989). Absorption through intact skin has not been adequately characterized. Since dermal contact is associated with skin irritation there must at least be local absorption of arsenic, if not systemic absorption (U.S. PHS, 1989).

**Distribution** - Inorganic arsenic is distributed throughout the body by the blood, and initially accumulates in liver, kidney, lung, spleen, aorta, skin, hair, and upper gastrointestinal tract. Retention depends on the specific arsenic species (U.S. PHS, 1989). The highest levels are found in hair and nails. Lungs and skin have higher concentrations than other soft tissues. A portion of inhaled arsenic may bind irreversibly to lung tissue (U.S. PHS, 1989).

**Metabolism** - In humans and most animals, trivalent inorganic arsenic is metabolized to dimethylarsinic acid (DMA) and monomethylarsonic acid (MMA). Methylation occurs largely in the liver. The methylation enzyme system may become saturated beginning at a dose between 0.5 and 1 mg/day (U.S. PHS, 1989). Arsenic is excreted largely in the urine of humans, in the proportions of about 60 percent DMA, 20 percent MMA, and 20 percent inorganic compound. The complex forms of arsenic found in fish and shellfish are rapidly excreted in the urine (U.S. PHS, 1989).

Arsenic is thought to be an essential element required in the diet. However, there has never been an identified case of arsenic deficiency in humans (U.S. PHS, 1989).

**Carcinogenicity** - Arsenic is classified by the U.S. EPA as a Group A, human carcinogen, based on EPA's cancer risk assessment guidelines (U.S. EPA, 1994). This category applies to agents for which sufficient evidence exists and supports causal association between exposure and cancer in humans. The inhalation unit risk is  $4.3 \times 10^{-3}$  per  $\mu\text{g}/\text{m}^3$ , based on increased lung cancer mortality in smelter workers exposed to arsenic (U.S. EPA, 1994).

The administrator of the EPA has recommended the adoption of a unit risk of  $5 \times 10^{-5}$  per  $\mu\text{g}/\text{L}$  for exposure to arsenic in drinking water (U.S. EPA, 1994). However, risk managers are mandated to note that risk estimates associated with ingested inorganic arsenic could be modified downwards by as much as an order of magnitude, relative to estimates for other carcinogens (U.S. EPA, 1994). The drinking water unit risk was based on increases in the incidence of nonmelanoma skin cancer in a Taiwanese population exposed to high arsenic levels in drinking water. Only a fraction of these skin cancers are fatal. Using standard exposure assumptions (2 L/70 kg/day water ingestion) this unit risk is equivalent to an oral slope factor in water of 1.75 per mg/kg/day dose; this slope factor is used in this assessment for all ingestion exposures.

**Threshold Effects** - The toxic effect of arsenic ingestion with the lowest threshold is keratosis of the skin, with associated hyperpigmentation, observed in human populations consuming water containing arsenic at concentrations of 0.17 mg/L or higher (U.S. EPA, 1994). Several other

toxic effects have been noted such as anemia, leukopenia, gastrointestinal distress, hepatic and renal injury, and neuropathies (U.S. PHS, 1989). Chronic oral exposures of humans to arsenic has been shown to cause peripheral neuropathy, skin lesions, and a peripheral circulatory disease called blackfoot, characterized by gangrene of the extremities (U.S. EPA, 1984). The EPA has selected  $3 \times 10^{-4}$  mg/kg/day as the chronic oral reference dose based on keratosis, hyperpigmentation, and possible vascular complications, all in humans (U.S. EPA, 1994). An uncertainty factor of 3 was used.

Occupational exposure to airborne arsenic is associated with some risk of hyperpigmentation and keratosis, and irritation of the skin and mucous membranes (U.S. PHS, 1989). Inhalation of some arsenic compounds causes an acute toxicity, including skin lesions, cardiovascular and respiratory effects, and peripheral neuropathy (U.S. EPA, 1984). The EPA has not selected a reference dose for inhalation of arsenic.

**Reproductive/Developmental Effects** - According to the U.S. EPA Gold Book, arsenic is more toxic in early life stages than chronically (U.S. EPA, 1986). Some prominent developmental effects include decreased fetal weights and the occurrence of fetal malformations (U.S. EPA, 1984). Possibly in support of this, a study by Boxley, et al. (U.S. EPA, 1984) indicated that a single oral dose of 40 to 45 mg/kg body weight on any day of gestation between days 8 and 15 will produce adverse effects in developing mice.

## References

- U.S. EPA, 1984. Health Effects Assessment for Arsenic. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1986. Quality Criteria for Water. EPA/440-5-86-001.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Arsenic, dated 6/1/94.
- U.S. Public Health Service, 1989. Toxicological Profile for Arsenic.

## **Barium**

**Absorption** - Results of studies with experimental animals suggest that the rate and extent of absorption of barium from the respiratory tract depends on the exposure level. Initially, barium is deposited in the nasal region and eventually it is absorbed into the body (U.S. PHS, 1990). Barium is poorly absorbed from the gastrointestinal tract upon oral exposure.

**Distribution** - Barium injected into the mouse is distributed widely, but principally in the bone (U.S. EPA, 1987).

**Metabolism** - Barium levels in human bone do not change markedly with increasing age (U.S. EPA, 1987).

**Carcinogenicity** - Barium has not been classified for carcinogenicity on IRIS (U.S. EPA, 1992).

**Threshold Effects** - The chronic oral RfD for barium was generated based on humans drinking water with 10 mg/L barium in the form of barium chloride, where increased blood pressure was the critical effect (U.S. EPA, 1992). The chronic oral RfD is  $7.0 \times 10^{-2}$  mg/kg/day (U.S. EPA, 1992).

**Reproductive/Developmental Effects** - No human or animal studies could be located regarding reproductive effects following exposure to barium. Developmental effects were reported in one study where female rats were orally administered barium carbonate and the observed effects included increased mortality and disturbances in liver function (U.S. PHS, 1990).

## **References**

U.S. EPA, 1987. Health Advisories for Legionella and Seven Inorganics. March 1987. PB87-235586.

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Barium, dated 1/20/92.

U.S. Public Health Service, 1990. Toxicological Profile for Barium.

### **Beryllium**

**Absorption** - Based on animal studies, compounds of beryllium appear to be poorly absorbed both through the GI tract and the skin. Absorption most readily occurs via inhalation. Factors such as dose, particle size and solubility play an important role in determining absorption rates and clearance (U.S. PHS, 1987). Acute dermal exposure to soluble beryllium compounds may cause contact dermatitis due to its ability to penetrate the skin.

**Distribution** - Human tissue analysis from occupationally exposed workers indicates that inhaled beryllium is found at highest concentrations in the lungs and bones, with lower concentrations in the liver and kidneys. Hamster studies indicate that upon oral administration of beryllium, appreciable concentrations could be observed in the liver, large and small intestines, kidneys, lung, stomach and spleen (U.S. PHS, 1987).

**Metabolism** - Beryllium and its compounds are not biotransformed; however, soluble beryllium compounds are partially converted to more soluble forms in the lungs (U.S. PHS, 1987). As observed in animal studies, beryllium is primarily excreted in the feces, and only trace amounts appear in the urine. This observation has been attributed to beryllium's poor absorption through the GI tract.

**Carcinogenicity** - Beryllium is classified in Group B2, as a probable human carcinogen, based on lung cancer resulting from inhalation in rats and monkeys and osteosarcomas resulting from intravenous or intramedullary injection in rabbits (U.S. EPA, 1993). The oral slope factor for beryllium is 4.3 per mg/kg/day, based on a slight, statistically insignificant increase in total cancers in rats drinking beryllium sulfate in drinking water at 5 ppm (U.S. EPA, 1993).

**Threshold Effects** - The chronic oral RfD for beryllium was generated from a NOAEL of 0.54 mg/kg bw/day in a rat drinking water bioassay (U.S. EPA, 1993). Exposure was for the lifetime of the animals. The rats were dissected after natural death and gross and microscopic changes were noted in the heart, kidney, liver and spleen. A chronic oral RfD of  $5 \times 10^{-3}$  mg/kg/day was generated by the U.S. EPA (U.S. EPA, 1993); based on no adverse effects observed. An oral uncertainty factor of 100 reflects compensation for inter-species differences and for the protection of sensitive human subpopulations. No inhalation RfD is available.

**Reproductive/Developmental Effects** - Data regarding reproductive toxicity resulting from beryllium exposure could not be located. Developmental effects have been observed. Injection of beryllium salts into pregnant mice resulted in behavioral abnormalities in the offspring. Intratracheal administration of beryllium oxide and chloride to pregnant rats resulted in increased fetal mortality, decreased fetal weight and increased internal abnormalities (U.S. PHS, 1987).

## **References**

- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Beryllium, dated 2/1/93.
- U.S. PHS, 1987. Toxicological Profile for Beryllium.

## **Cadmium**

**Absorption** - The EPA assumes that approximately 2.5% of cadmium in food is absorbed and approximately 5% of cadmium in water is absorbed. Cadmium is also absorbed through the lung after inhalation (30 to 50%), but very little enters the body through the skin (U.S. PHS, 1988).



**Distribution** - Cadmium is widely distributed throughout the body. The primary organs of concentration are the kidney and liver (U.S. EPA, 1987).

**Metabolism** - Some of the cadmium in the body complexes with a low molecular weight protein called metallothionein (U.S. EPA, 1987). The half-life of cadmium in humans has been estimated as between 10 and 33 years (U.S. EPA, 1987). In an EPA model it is assumed that 0.01% of the cadmium body burden is eliminated each day (U.S. EPA, 1994). Once cadmium enters the body it is strongly retained, so even small chronic exposures can result in high levels of cadmium in the body (U.S. PHS, 1988).

**Carcinogenicity** - Cadmium is classified a B1, probable human carcinogen, based on limited evidence from an epidemiologic study on inhalation exposures to cadmium by smelter workers, and sufficient evidence in animal studies (U.S. EPA, 1994). Exposure to cadmium as cadmium chloride in air by rats resulted in significant increases in lung tumors. Intratracheal exposure to rats resulted in mammary tumors in females and tumors in multiple sites in males. Tumors have been reported in rats and mice following injection exposures to cadmium compounds. There is insufficient data to quantify the carcinogenicity of cadmium by the oral route (U.S. EPA, 1994).

**Threshold Effects** - There are two chronic oral reference doses (RfDs) for use when evaluating oral exposure to cadmium. The RfDs are not based on any one study, but rather on the highest level of cadmium in the human renal cortex not associated with proteinuria, combined with a toxicokinetic model (U.S. EPA, 1994). Since the absorption of cadmium from water and food varies, two RfDs have been developed:  $5 \times 10^{-4}$  mg/kg/day for exposure to cadmium in water and  $1 \times 10^{-3}$  mg/kg/day for exposure to cadmium in food (U.S. EPA, 1994).

**Reproductive/Developmental Effects** - Cadmium exposure has not been shown to results in developmental or reproductive effects in humans. Exposure to cadmium by gavage in pregnant rats has resulted in decreased birth weight, impaired neurologic development in the fetus, and fused or absent legs in rat fetuses. Inhalation studies have noted decreased maternal weight gain

and decreased fetal weights in rats (U.S. PHS, 1988). No reproductive effects have been reported following inhalation exposures in animals.

## **References**

- U.S. EPA, 1987. Health Advisories for Legionella and Seven Inorganics. March, 1987. PB87-235586.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Cadmium, dated 2/7/94.
- U.S. Public Health Service, 1988. Toxicological Profile for Cadmium.

## **Chromium**

The toxicity of chromium is dependent on the form present. This toxicity profile covers both Chromium III (trivalent chromium, or Cr III) and Chromium VI (hexavalent chromium, or Cr VI). Trivalent chromium is an essential nutrient.

**Absorption** - Chromium can enter the body by ingestion, inhalation and dermal exposures. Entry by ingestion and inhalation are expected to be the primary routes of exposure for the general population (U.S. PHS, 1989). However, only about one percent of dietary chromium is absorbed (Hammond and Beliles, 1980). A typical daily intake is 60 µg per day, 10 µg of which are from water (Hammond and Beliles, 1980).

**Distribution** - Distribution studies in animals have shown high levels of chromium in the kidney, lungs, and spleen (U.S. PHS, 1989).

**Metabolism and Excretion** - There is some evidence that some Cr VI is reduced to Cr III, an essential element in the body. Information on excretion was not located.

**Carcinogenicity** - Chromium VI is classified a Group A human carcinogen by inhalation, based on human data supported by animal data, epidemiologic studies of chromate production in four countries, and three studies of the chrome pigment industry in Norway, England, the Netherlands, and Germany. All these studies have linked exposure to lung cancer. Implant site tumors developed when Cr VI was injected into various tissues in rats (U.S. EPA, 1994a). There are no long-term studies of ingested Cr VI. There is no evidence of carcinogenicity for Cr III; whereas Cr VI has been shown to be both carcinogenic and mutagenic, Chromium III has not (U.S. EPA, 1994b).

**Threshold Effects** - Chromium VI is an irritant that can result in adverse effects at the point of contact resulting in ulcers of the skin, irritation of the nasal mucosa and gastrointestinal tract. It also can cause adverse effects in the kidney and liver (U.S. PHS, 1989). The chronic oral reference dose (RfD) developed by the EPA for Cr VI is  $5 \times 10^{-3}$  mg/kg/day, based on oral ingestion by rats of potassium chromate ( $K_2CrO_4$ ) (U.S. EPA, 1994a). The chronic oral RfD for Cr III as an insoluble salt is 1 mg/kg/day (U.S. EPA, 1994b), based on oral ingestion of chromic oxide ( $Cr_2O_3$ ) by rats. No critical effect was observed in the studies from which either of the RfDs were derived (U.S. EPA, 1994a; 1994b).

**Reproductive and Developmental Effects** - Studies evaluating developmental effects in humans by oral, inhalation or dermal exposures are not adequate to show effects from either Cr III or Cr VI. Increased fetal death and external abnormalities have been documented following injected exposures in hamsters (U.S. PHS, 1989).

## References

- Hammond, P.B., and R.P. Beliles, 1980. "Metals" in Casarett and Doull's Toxicology, 2nd ed. Doull, Klaasen, and Amdur, eds. MacMillan, New York.
- U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Chromium (VI), dated 9/1/94.
- U.S. EPA, 1994b. Integrated Risk Information System (IRIS) online database; Chromium (III), Insoluble Salts, dated 9/1/94.

U.S. PHS, 1989. Toxicological Profile for Chromium. Prepared for Agency for Toxic Substances and Disease Registry (ATSDR), Atlanta, GA.

## **Cobalt**

**Absorption** - Upon inhalation, cobalt is deposited in the upper and lower respiratory tract and is subsequently absorbed by several mechanisms (U.S. PHS, 1990). These particles are usually translocated into the blood upon dissolution or mechanically transferred to the GI tract by mucociliary action of the respiratory tract and swallowing. In humans, iron deficiency leads to a more widespread absorption of cobalt from the GI tract upon oral administration. No human dermal data exist regarding cobalt absorption.

**Distribution** - Cobalt is found in most human body tissues, since its an essential element, with the highest concentrations found in the liver. Other tissues in which cobalt has been found include muscle, lung, lymph nodes, heart, skin, bone, hair, stomach, brain, pancreatic juice, kidneys, plasma, and urinary bladder (U.S. PHS, 1990).

**Metabolism** - Cobalt is a metal and an essential element, and as such, it is not metabolized.

**Carcinogenicity** - No data exist to assess carcinogenic effects.

**Threshold Effects** - Insufficient data exist to establish oral and inhalation reference doses.

**Reproductive/Developmental Effects** - No studies regarding reproductive effects in humans exposed to cobalt have been located; however, in rats, testicular degeneration and atrophy have been reported, following ingestion of water or food containing cobalt. No developmental effects have been observed on human fetuses of pregnant women treated with cobalt chloride in order to raise their hematocrit and hemoglobin levels (U.S. PHS, 1990).

## **References**

U.S. Public Health Service, 1990. Toxicological Profile for Cobalt.

## **Copper**

**Absorption** - Absorption of ingested copper ranges from 15 to 97% (U.S. EPA, 1984). Quantitative data for inhalation absorption are not available.

**Distribution** - Absorbed copper is rapidly transported to blood serum and taken up by the liver and further transported in the blood plasma. The highest tissue concentrations are found in the liver and brains (U.S. EPA, 1984).

**Metabolism** - Copper is incorporated into copper proteins in mammals (U.S. EPA, 1984). Copper is an essential nutrient in trace quantities.

**Carcinogenicity** - Copper is classified in Group D due to a lack of human data, deficient animal data, and ambiguous mutagenicity data (U.S. EPA, 1992).

**Threshold Effects** - Ingestion of copper results in a number of elimination responses such as nausea, vomiting, gastritis, and diarrhea. Systematic toxic effects can include hemolysis, liver problems, gastrointestinal bleeding, anemia, convulsions, and death (Clement, 1985). Exposure to copper dust can cause short-term illness characterized by chills, fever, aching muscles, and headache. No chronic oral RfD has been calculated for copper (U.S. EPA, 1992). The drinking water action level of 1.3 mg/L is presented in HEAST (U.S. EPA, 1994).

**Reproductive/Developmental Effects** - No studies documenting reproductive and/or developmental toxicity were found.

## **References**

- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- U.S. EPA, 1984. Health Effects Assessment for Copper. Office of Research and Development. Cincinnati, Ohio.
- U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Copper, dated 1/22/92.
- U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development - Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).

## **Lead**

**Absorption** - Oral absorption of lead has been estimated at 15% for adults and 50% for children, with adult absorption of lead ranging as high as 45% under fasting conditions (U.S. PHS, 1990). Inhalation absorption of the inhalable fraction of lead particles approaches 100% over time. Dermal absorption ranged from 0 to 0.3% in one study (U.S. PHS, 1990).

**Distribution** - Distribution of lead in the body is described with a three compartment model, including blood, soft tissue, and bone (U.S. PHS, 1990). Following chronic exposures, most of the body burden of lead is in bone (U.S. PHS, 1990).

**Metabolism** - Inorganic lead does not undergo metabolism in the body (U.S. PHS, 1990).

**Carcinogenicity** - Based on sufficient statistically significant increases in renal tumors in rats, lead is classified in Group B2 - as a probable human carcinogen (U.S. EPA, 1993). However, the Carcinogen Assessment Group has recommended that a numerical estimate of carcinogenicity not be used, due to the many uncertainties associated with lead (U.S. EPA, 1993).

**Threshold Effects** - Lead decreases circulating vitamin D and at high levels can produce encephalopathy, colic, anemia, and neuropathy. Because lead accumulates in bone, from which it can be mobilized and redistributed in the body, past cumulative exposure contributes to the risk (U.S. PHS, 1990). Some adverse health effects, such as changes in blood enzymes and the neurobehavioral development of children, occur at extremely low blood lead levels (U.S. EPA, 1993). Because these effects occur essentially without a threshold, the EPA RfD work group concluded that it was inappropriate to develop an RfD for inorganic lead (U.S. EPA, 1993).

**Reproductive/Developmental Effects** - Lead produces a variety of reproductive effects in both male and female rats (U.S. PHS, 1990). Female rats exhibited irregular estrous cycles, ovarian cysts, and reduced egg production, while male rats experienced testicular atrophy, decreased sperm count, and reduced sperm mobility (U.S. PHS, 1990). Decreased birth weights and an increase in the number of stillbirths also resulted (U.S. PHS, 1990).

## **References**

- U.S. EPA, 1993. Integrated Risk Information System (IRIS) online database; Lead, dated 11/1/93.
- U.S. Public Health Service, 1990. Toxicological Profile for Lead.

## **Manganese**

**Absorption** - Inhaled manganese is absorbed directly into the bloodstream only if the particles are small enough to reach the alveoli. Larger particles would be cleared by mucociliary action and swallowed. From a human study of inhaled manganese aerosol absorption in which roughly half of the manganese deposited in the lungs was recovered in waste within four days, EPA reported a conclusion that relatively little pulmonary absorption occurred (U.S. EPA, 1984). The rationale for this conclusion was not elaborated. Large oral doses of manganese salts cause

gastrointestinal irritation, which reduces absorption of high doses (Hammond and Beliles, 1980). The principal portion of intake is from food (Hammond and Beliles, 1980).

**Distribution** - Enterohepatic circulation of manganese has been reported (U.S. EPA, 1984). This circulation consists of release of manganese in the bile and reabsorption in the duodenum. A fairly constant body burden of 20 mg appears to be maintained by a homeostatic system (Hammond and Beliles, 1980). The highest concentrations are found in the liver, kidney, intestine, and pancreas (Hammond and Beliles, 1980). Manganese does not accumulate in the lungs over time, even with chronic exposure (Hammond and Beliles, 1980).

**Metabolism and Excretion** - Manganese is an essential element in the diet (U.S. EPA, 1994). Since manganese in any valence state promotes rapid elimination of radiolabeled manganese (Hammond and Beliles, 1980), it is likely that the various valence states are interconvertible in the body. Excretion is predominantly through bile (Hammond and Beliles, 1980).

**Carcinogenicity** - Manganese salts have produced tumors in mice when injected. However, there is insufficient evidence to consider manganese as a carcinogen; it is classified in Group D (U.S. EPA, 1994).

**Threshold Effects** - Manganese is an essential nutrient. The National Resource Council determined that 2-5 mg of manganese is "safe and adequate" for adults, which is equivalent to 0.03 to 0.07 mg/kg/day. Oral reference doses (RfDs) are available for manganese in food and manganese in water. The chronic oral RfD for manganese in food is 0.14 mg/kg/day (U.S. EPA, 1994), based on the lack of central nervous system effects in humans who consumed a normal diet (U.S. EPA, 1994). The chronic oral RfD for manganese in water is 0.005 mg/kg/day (U.S. EPA, 1994), based on the lack of central nervous system effects in humans consuming water with an average manganese content of 167  $\mu\text{g/L}$ . An uncertainty factor of 1 was used to derive the food and water RfDs (U.S. EPA, 1994). No RfDs are specifically designated for exposure to manganese in soil.



**Reproductive and Developmental Effects** - One EPA source reported that exposure to manganese has been connected to impotency, increased stillbirths, and an increase in the number of spontaneous abortions in humans (U.S. EPA, 1984). Another reported that no epidemiological studies had suggested teratogenic or reproductive effects in humans (Clement, 1985). Mice exposed to manganese exhibited retarded sexual development while rats showed a decrease in testosterone without interference to reproductive success (U.S. EPA, 1984).

## **References**

- Clement Associates, Inc., 1985. Chemical, Physical and Biological Properties of Compounds Present at Hazardous Waste Sites. Prepared for U.S. EPA.
- Hammond, P.B. and R.P. Beliles, 1980. "Metals" in Casasett and Doull's Toxicology, Doull, Klaasen, and Amdur, eds. New York, MacMillan.
- U.S. EPA, 1984. Health Effects Assessment for Manganese (and Compounds). Office of Research and Development, Cincinnati, Ohio.
- U.S. EPA, 1994. Integrated Risk Information System (IRIS) online database; Manganese, dated 4/6/94.

## **Mercury**

**Absorption** - Data on the absorption of inorganic mercury are limited. However, results from animal and human studies indicate that inorganic mercury is readily absorbed through the respiratory tract and minimally absorbed from the gastrointestinal tract (U.S. PHS, 1988). A comparative rate of absorption of inorganic mercury through the skin is unavailable, although animal studies report uptake after dermal exposure (U.S. PHS, 1988).

**Distribution** - Data from animal studies involving inhalation exposures indicate that inorganic mercury, which is highly diffusible and lipophilic once absorbed, can be found in all body tissues. Accumulation of inorganic mercury is reported to occur in the kidneys, intestinal mucosa, epithelial layers of the skin, salivary and sweat glands, pancreas, testes, prostate, brain, and, to some extent, the lung and pleural cavities (U.S. PHS, 1988).

**Metabolism** - Inorganic mercury is rapidly oxidized in red blood cells and the lungs to its divalent form and subsequently reduced to elemental mercury (U.S. PHS, 1988). Results from studies with rats suggest that inorganic mercury is also oxidized by the liver. Mercury is ultimately eliminated in the urine and feces; however, exhalation and excretion in saliva and sweat may also occur (U.S. PHS, 1988).

**Carcinogenicity** - Due to lack of human data and inadequate animal data, mercury has been classified in Group D (U.S. EPA, 1994a).

**Threshold Effects** - The chronic oral RfD was determined to be  $3 \times 10^{-4}$  mg/kg/day (U.S. EPA, 1994b). This value was determined from several oral, parenteral studies in the Brown Norway rat. The critical effect observed was kidney toxicity. An oral RfD uncertainty factor of 1000 was used (U.S. EPA, 1994b).

**Reproductive/Developmental Effects** - No reliable data are available on the reproductive or developmental effects of inorganic mercury.

## **References**

U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Mercury, dated 4/6/94.

U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development. Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).

U.S. Public Health Service, 1988. Toxicological Profile for Mercury.

## **Nickel**

**Absorption** - Nickel is absorbed primarily through the skin and gastrointestinal tract. Animal studies have shown that the rate of absorption of nickel, following inhalation exposure, is

inversely related to particle size; where smaller particles have a greater capability of infiltrating lung tissue (U.S. PHS, 1987).

**Distribution** - Data from animal studies indicate that the location of nickel accumulation in the body may depend on the exposure route. Both inhalation and oral exposures result in accumulation of nickel by the lung and kidneys; however, elevated concentrations of nickel in the heart, central nervous system, and testes have also been reported following oral exposure (U.S. PHS, 1987). Accumulation of nickel in the hair also occurs (U.S. PHS, 1987) and may be exacerbated by dermal exposure. Nickel is a normal component of blood serum in humans at concentrations of approximately 1.6 µg/L (U.S. PHS, 1987).

**Metabolism** - Absorbed nickel is transported in the vascular system bound to serum albumin, L-histidine, and 2-macroglobulin. Nickel is transferred across membranes to target organs as L-histidine, and may be excreted in the urine, after passing through the kidneys, or be released in sweat (U.S. PHS, 1987). Nickel that is not absorbed from the gastrointestinal tract is excreted in the feces (U.S. PHS, 1987).

**Carcinogenicity** - Based on sufficient evidence of cancer in humans from inhalation exposure, nickel is classified in Group A, as a human carcinogen by inhalation (U.S. EPA, 1994b). Increased risks of lung and nasal cancer in humans exposed to nickel refinery dust (most of which was believed to have been nickel subsulfide), increased tumor incidences in animals by several routes of administration in several animal species and strains, and positive results in genotoxicity assays form the basis for the classification. Exposure to nickel compounds by the oral route has not been classified for carcinogenicity.

**Threshold Effects** - A chronic oral RfD of  $2 \times 10^{-2}$  mg/kg/day was determined for nickel, based on a chronic oral rat study; nickel from nickel sulfate was administered in the diets of rats in a 2 year study (U.S. EPA, 1994a). Decreased body and organ weights are listed as the critical effects.

**Reproductive/Developmental Effects** - Reported reproductive effects are based on rat studies and include testicular degeneration, resulting in a decrease in male fertility, and pregnancy complications in females (U.S. PHS, 1987). Developmental effects are supported by data from animal studies and include low birth weight, embryonic malformations, and stillbirths.

## **References**

U.S. EPA, 1994a. Integrated Risk Information System (IRIS) online database; Nickel, dated 8/1/94.

U.S. EPA, 1994b. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development. Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).

U.S. Public Health Service, 1987. Toxicological Profile for Nickel.

## **Vanadium**

**Absorption** - Once inhaled, vanadium absorption occurs in humans as observed primarily in the occupational setting. Intratracheal administration of vanadium in rats support the evidence that vanadium absorption in humans may occur following acute exposure (U.S. PHS, 1990). The absorption of vanadium through the gastrointestinal tract or the skin is very low.

**Distribution** - Data regarding distribution of vanadium in humans immediately following exposure is inconclusive. At autopsy, vanadium has been detected primarily in the lungs and intestines of humans (U.S. PHS, 1990). Rapid distribution occurs in rats, upon acute intratracheal administration. Retention of vanadium primarily occurs in the bones (U.S. PHS, 1990).

**Metabolism** - Because vanadium is an element, it is not metabolized. However, in the body, vanadium interconversion occurs to two oxidation states: vanadyl (the tetravalent form) and

vanadate (the pentavalent form); vanadate being more toxic than vanadyl. Vanadium in the plasma may exist in a bound or unbound form (U.S. PHS, 1990).

**Carcinogenicity** - EPA has not classified vanadium for carcinogenicity.

**Threshold Effects** - Based on a chronic oral lifetime drinking water study done in rats, a chronic oral RfD of  $7 \times 10^{-3}$  mg/kg/day was derived (U.S. EPA, 1994). The RfD is based on no observed effects in rats administered vanadium from vanadyl sulfate in drinking water for a lifetime (U.S. EPA, 1994). An uncertainty factor of 100 was used.

**Reproductive/Developmental Effects** - No studies have been located regarding reproductive effects in humans or animals (U.S. PHS, 1990). Studies have not identified developmental effects from vanadium exposure (U.S. PHS, 1990). One study showed no embryoletality, teratogenicity or significant skeleton or visceral abnormalities in pups exposed during gestation (U.S. PHS, 1990). There was an increase in facial and dorsal hemorrhage but its toxicological significance is unknown.

## **References**

U.S. EPA, 1994. Health Effects Assessment Summary Tables, Annual FY-1994. Office of Research and Development. Office of Emergency and Remedial Response, U.S. EPA, Washington, D.C. OERR 9200.6-303(94-1).

U.S. Public Health Service, 1990. Toxicological Profile for Vanadium.

## **Zinc**

**Absorption** - Approximately 20 percent to 30 percent of zinc ingested is absorbed in the gastrointestinal tract. Inhalation absorption is assumed since toxicity results from inhalation exposures to zinc oxide fume, but this absorption is not quantified (U.S. PHS, 1989).

**Distribution** - The majority of zinc is in the prostate, muscle and bone. It is also found in a number of other organs, such as the kidneys, liver, and heart (U.S. PHS, 1989).

**Metabolism** - Studies indicate that zinc levels in humans are homeostatically controlled, meaning that absorption and excretion of zinc vary depending on bodily needs (U.S. PHS, 1989).

**Carcinogenicity** - There is no evidence that zinc is a carcinogen and is, therefore, classified in Group D (U.S. EPA, 1992).

**Threshold Effects** - Zinc is a necessary metal for the human body. The chronic oral RfD is 0.3 mg/kg/day, based on decreased blood enzyme from therapeutic dosages to humans (U.S. EPA, 1992). The U.S. EPA has concluded that adverse health effects are not expected from zinc in drinking water, so it is not presently regulated.

**Reproductive/Developmental Effects** - Zinc-induced anemia can prevent reproduction. Elevated levels in the diet can reduce fetal body weights, decrease fetal concentrations of iron and copper, increase fetal resorption, and reduce growth in offspring (U.S. PHS, 1989).

## **References**

U.S. EPA, 1992. Integrated Risk Information System (IRIS) online database; Zinc, dated 10/7/92.

U.S. Public Health Service, 1989. Toxicological Profile for Zinc.

**APPENDIX H**  
**1986 Analytical and Field Data**  
**From Site 4**

# E.S.G., INC.

ENVIRONMENTAL SERVICE GROUP

520 VIRGINIA AVE.  
INDIANAPOLIS, IN 46203

317-635-1123

June 27, 1986



Lt. Ben Vohrees  
Indiana National Guard  
Hulman Regional Airport  
Terre Haute, IN 47803-5320

Re: Laboratory Numbers 861098-1 Through 861098-45  
Report for 37 Soil and 8 Water Samples  
Taken from Old Fuel Storage Area

Dear Lt. Vohrees:

One correction should be made in the results shown for samples no. 40 WS-9-10" and no. 43 WS-10-6". The Oil and Grease results were transposed for these two samples. The corrected readings should be:

		<u>Oil &amp; Grease</u>	<u>TOC</u>	<u>TOX</u>
#40	WS-9-10"	0.004%	46 ppm	30 ppb
#43	WS-10-6"	1.1%	1510 ppm	190 ppb

The EPA has no guidelines covering soils for Oil and Grease, Total Organic Carbon, or Total Organic Halogens. In consultation with Mr. George Oliver, Chief of Special Projects, Department of Environmental Management for Indiana, and Mr. Thomas M. Schubert, P.E., of Triad Associates, Inc., we found that these guidelines may be followed for reuse of the tested area.

If no soil is to be removed from the area and proper containment levees are in place, there should be no problem for new fuel storage tanks.

Water runoff should be prevented, or, if it does occur, it should be monitored.

If you have any questions or need further information, please feel free to contact our office.

Very truly yours,

E.S.G., INC.

Robert L. Kent, PhD  
President

RLK/bm

H-1



SAMPLE  
DATE!  
10 June 86

# OLD BLADDER AREA - HULMAN FLD., IND.

No.	Water or Soil Sample	DESCRIPTION	Augered Hole
1.	WS-5 (8 1/2")	6/9 - 1545 - 6/10	0915 overnight water Sample
2.	GS-4-1.5	SOIL SAMPLE 1.5' below	ST #4
3.	GS-4-3.0	SOIL SAMPLE 3.0' below	ST #4
4.	GS-3-1.5	SOIL SAMPLE 1.5' below	ST #3
5.	GS-3-3.0	SOIL SAMPLE 3.0 below (Hit Water/Rock)	ST #3 Piece of Field TILE FOUND
6.	GS-7-1.5	SOIL SAMPLE 1.5' below rocks & pebbles	ST #7
7	GS-7-3.0	SOIL SAMPLE 3.0' below SOIL & CLAY (BLUE CLAY) breakdown of (biodegradable) oily soil possibly	ST #7
8.	GS-5-1.5	SOIL SAMPLE 1.5' below SOIL & CLAY (BLUE CLAY) biodegradable oily soil possibly	ST #5
9	GS-5-3.0	SOIL SAMPLE 3.0' below SOIL & CLAY (BLUE CLAY) biodegradable oily soil possibly	ST #5

AMPCU  
DATE  
10 June 86

# OLD BLADDER AREA - HULMAN TID, IND.

No.	Water or Soil Sample	DESCRIPTION	
10.	GS-6-1.5	SOIL SAMPLE 1.5' below	ST#6
11.	GS-6-3.0	SOIL SAMPLE 3.0' below biodegradable oily soil possibly	
12.	GS-9-1.5	SOIL SAMPLE 1.5' below Normal looking soil	ST#9
13.	GS-9-3.0	SOIL SAMPLE 3.0' below SOIL & WATER	ST#9
14.	GS-8-1.5	SOIL SAMPLE 1.5' below looks clear	ST#8
15.	GS-8-3.0	SOIL SAMPLE 3.0' below Fuel in Clay soil	ST#8
16.	GS-8-4.0	SOIL SAMPLE 4.0' below slight Fuel in clay	ST#8
17.	GS-8-4.5	SOIL SAMPLE 4.5' below	ST#8
18.	GS-2-1.5	SOIL SAMPLE 1.5' below Some GRAVEL	ST#2

SAMPLE  
DATE:  
10 JUNE 86

# OLD BLADDER AREA - HULMAN FLD, IND.

No.	Water or Soil Sample	DESCRIPTION	
19.	GS-2-3.0	SOIL SAMPLE	3.0' Below ST#2
20.	GS-1-1.5	SOIL SAMPLE OILY SOIL	1.5' Below ST#1
21.	GS-1-3.0	SOIL SAMPLE FUEL IN SOIL (strong)	3.0' Below ST#1
22.	GS-1-4.0	SOIL SAMPLE FUEL IN SOIL	4.0' Below ST#1
23.	GS-10-4.0	SOIL SAMPLE FUEL IN SOIL (strong & heavy)	4.0' Below ST#1
24.	GS-10-4.5	SOIL SAMPLE FUEL IN SOIL	4.5' Below ST#1
25.	GS-11-1.5	SOIL SAMPLE	1.5' Below ST#11
26.	GS-8-5.5	CORE SAMPLE (SOIL SAMPLE)	5.5' Below ST#8
27.	GS-11-3.0	SOIL SAMPLE	3.0' Below ST#11

SAMPLE  
DATE:  
11 June 86

# OLD BLADDER AREA - HUGHAN FLD, IOWA.

28.	GS-14-1.5	SOIL SAMPLE	1.5' below	ST #14
29.	GS-14-3.0	SOIL SAMPLE	3.0' below	ST #14
30.	GS-13-1.5	SOIL SAMPLE	1.5' below	ST #13
31.	GS-13-3.0	SOIL SAMPLE	3.0' below	ST #13
32.	GS-13-4.5	SOIL SAMPLE	4.5' below	ST #13
33.	GS-14-4.5	SOIL SAMPLE	4.5' below	ST #14
34.	GS-15-4.5'	SOIL SAMPLE OILY CLAY SOIL	4.5' below	ST #15

34 GS - 15 - 4.5  
 35 GS - 12 - 6.0  
 36 GS - 12 - 1.5  
 37 GS - 12 - 3.0  
 38 WS - 4 - 7"  
 39 WS - 3 - 11"  
 40 WS - 9 - 10"  
 41 WS - 8 - 17"  
 42 WS - 2 - 9"  
 43 WS - 10 - 6"  
 44 WS - 11 - 8 1/2"  
 45 WS - 13 - 16"

SOIL SAMPLE 4.5' below  
 SOIL SAMPLE 7.5' BELOW ST  
 SOIL SAMPLE 1.5 AT #1  
 SOIL SAMPLE 3.0 AT #1  
 WATER SAMPLE 7" AT #1  
 WATER SAMPLE 11" AT #1  
 WATER SAMPLE 10" AT #1  
 WATER SAMPLE 17" AT #1  
 WATER SAMPLE 9" AT #1  
 WATER SAMPLE 6" AT #1  
 WATER SAMPLE 8 1/2" AT #1  
 WATER SAMPLE 16" AT #1

7 SCALE : 1" = 30'

TEAM: LT. VORHEES, ASST. <sup>2</sup> B2  
ART LEE, ANGSCID  
HANK LOWMAN, ANGSCID

EXISTING FENCE

Q 573

POB FACILITY  
PROJECT END

LEGAL

ST = STAKE #

Note: AVOIDED THE  
#1 DRILLED 1/4/10  
@ 1545  
SAMPLED 6/10/04  
@ 0915  
(Water & Soil)  
STS - Dry

POL FAULTS  
PROJECT BEGIN

TOP E OF  
DIKE AREA

2 OLD FUEL  
TANKS

H-7

EXISTING ROADWAY

OLD BLADDER AREA

HULMAN FIELD AFB, TERRE HAUTE, IND.

DRAWN BY:

ART LER  
NUGS/ONI

# E.S.G., INC.

ENVIRONMENTAL SERVICE GROUP

520 VIRGINIA AVE.  
INDIANAPOLIS, IN 46203

317-635-1123

June 27, 1986



Lt. Ben Vohrees  
Indiana National Guard  
Hulman Regional Airport  
Terre Haute, IN 47803-5320

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The EPA has no guidelines covering soils for Oil and Grease, Total Organic Carbon, or Total Organic Halogens. In consultation with Mr. George Oliver, Chief of Special Projects, Department of Environmental Management for Indiana, and Mr. Thomas M. Schubert, P.E., of Triad Associates, Inc., we found that these guidelines may be followed for reuse of the tested area.

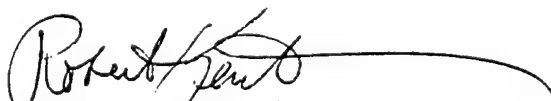
If no soil is to be removed from the area and proper containment levees are in place, there should be no problem for new fuel storage tanks.

Water runoff should be prevented, or, if it does occur, it should be monitored.

If you have any questions or need further information, please feel free to contact our office.

Very truly yours,

E.S.G., INC.

  
Robert L. Kent, PhD  
President

RLK/bm

H-8

SOIL & WATER SAMPLE ANALYSIS  
TOIN  
OLD BLADDER AREA  
AT  
HULMAN FIELD ANGB, INT.

DATE SAMPLED: 10-11 JUNE 86

SAMPLING TEAM: LT. BEN VORHEES, <sup>ASSIST.</sup> BCE  
ART LEE, ANGSC/DEV  
HANK LOWMAN, ANGSC/DEV

EQUIP. USED: MECH. AUGER, MEASURING WHEEL, STEAM  
CLEANING MACHINE, TECHNICAL GRADE -  
METHYL ALCOHOL, GLASS BALLER, PVC PIPING

WEATHER COND.: CLOUDS 85°, OFF & ON SHOWERS



4 JUNE 86  
10 JUNE 86

CLOUDY 80  
CLOUDY 85°, RAIN & SHOWERS (OFF 100)

SCALE: 1" = 20'

TEAM: L.J. VORLERS, 1st Lt.  
ART LEE, AUGSCOR  
HANK LOWMEYER, AUGSCOR

EXISTING FENCE

POL FACILITY  
PROJECT END

LEGEND

STATION

NOTE: AUGURED H  
#1 TUNNEL L  
@ 104  
SAMPLED 6/10/  
@ 091

POL FACILITY  
PROJECT BEGIN

TOP E OF  
DIKE AREA

2 OLD FUEL  
TANKS

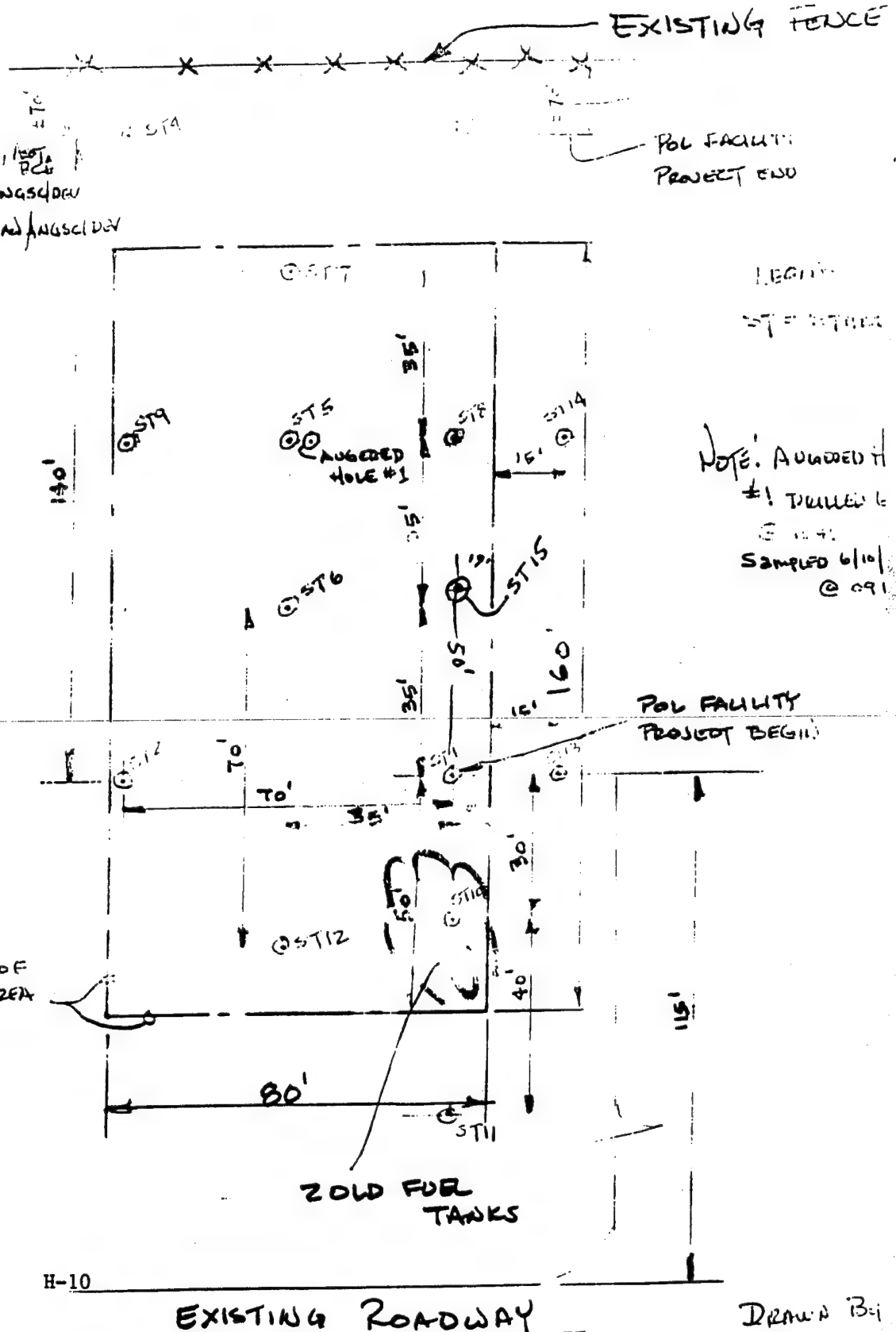
H-10

EXISTING ROADWAY

OLD BLADDER AREA

HULMAN FIELD AUGB, TERRE HAUTE, IND.

DRAWN BY  
ART LEE  
AUG 86



# E.S.G., INC.

ENVIRONMENTAL SERVICE GROUP

520 VIRGINIA AVE.  
INDIANAPOLIS, IN 46203

317-635-1123

June 27, 1986



Lt. Ben Vohrees  
Indiana National Guard  
Hulman Regional Airport  
Terre Haute, IN 47803-5320

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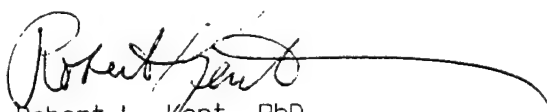
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If you have any questions or need further information, please feel free to contact our office.

Very truly yours,

E.S.G., INC.

  
Robert L. Kent, PhD  
President

RLK/bm

H-11

# E.S.G., INC.

ENVIRONMENTAL SERVICE GROUP

520 VIRGINIA AVE.  
INDIANAPOLIS, IN 46203

317-635-1123

June 23, 1986



Base Contracting Office  
Indiana Air National Guard  
Hulman Regional Airport  
Terre Haute, IN 47803-5320

## I N V O I C E

<u>LAB NUMBER</u>	<u>DESCRIPTION</u>	<u>PRICE</u>
61098-1 Through 45	TESTS PERFORMED ON WATER AND SOIL SAMPLES	\$6,575.00
CONTRACT/PURCH. ORDER NO. DAHA12-86-M-6441		
TOTAL AMOUNT DUE THIS INVOICE <u>\$6,575.00</u>		

THANK YOU!

TERMS: NET 30 DAYS - BALANCES BEAR A MONTHLY PERIODIC RATE OF  
1 3/4% BEING AN ANNUAL PERCENTAGE RATE OF 21%

H-12

# E.S.G., INC.

ENVIRONMENTAL SERVICE GROUP

520 VIRGINIA AVE.  
INDIANAPOLIS, IN 46203

317-635-1123

June 23, 1986



Indiana Air National Guard  
HQ 181st Tactical Fighter Group  
Hulman Regional Airport  
Terre Haute, IN 47803-5000

LABORATORY TESTING NUMBERS 861098-1 through 45

	<u>Oil &amp; Grease</u>	<u>TOC</u>	<u>TOX</u>
#1 WS-5-8.5"	0.007%	31 ppm	45ppb
#2 GS-4-1.5	0.17 %	1.4 %	64ug/g
#3 GS-4-3	0.19 %	2.4 %	89ug/g
#4 GS-3-1.5	0.31 %	2.0 %	48ug/g
#5 GS-3-3	0.06 %	1.7 %	103ug/g
#6 GS-7-1.5	0.79 %	1.6 %	106ug/g
#7 GS-7-3.0	0.14 %	2.0 %	65ug/g
#8 GS-5-1.5	0.47 %	1.8 %	82ug/g
#9 GS-5-3.0	0.16 %	1.9 %	74ug/g
#10 GS-6-1.5	0.61 %	2.3 %	110ug/g
#11 GS-6-3.0	0.91 %	2.0 %	62ug/g
#12 GS-9-1.5	0.46 %	3.0 %	690/680 ug/g
#13 GS-9-3.0	0.93 %	1.5 %	72ug/g
#14 GS-8-1.5	0.32 %	1.5 %	79ug/g
#15 GS-8-3.9	0.28 %	1.1 %	34ug/g
#16 GS-8-4.0	0.03 %	1.2 %	34ug/g
#17 GS-8-4.5	0.51 %	2.0 %	55ug/g
#18 GS-2-1.5	0.07 %	1.7 %	96ug/g
#19 GS-2-3.0	0.70 %	1.9 %	72ug/g
#20 GS-1-1.5	0.04 %	1.1 %	70ug/g
#21 GS-1-3.0	0.005%	1.2 %	62ug/g
#22 GS-1-4.0	0.01 %	2.0 %	77ug/g
#23 GS-10-3.0	0.01 %	1.7 %	94ug/g
#24 GS-10-4.5	0.02 %	0.8 %	60ug/g
#25 GS-11-1.5	0.007%	2.2 %	125ug/g
#26 GS-8-5.5	0.03 %	1.8 %	110ug/g
#27 GS-11-3.0	0.15 %	1.9 %	53ug/g
#28 GS-14-1.5	0.19 %	1.6 %	94ug/g
#29 GS-14-3.0	0.09 %	2.4 %	103ug/g
#30 GS-13-1.5	0.02 %	2.1 %	113ug/g
#31 GS-13-3.0	0.005%	2.0 %	130ug/g
#32 GS-13-4.5	0.02 %	2.3 %	82ug/g
#33 GS-14-4.5	0.04 %	2.1 %	125ug/g
#34 GS-15-4.5	0.16 %	1.6 %	84ug/g
#35 GS-15-6.0	0.006%	2.1 %	108ug/g

high TOX \*

extra examination

high TOX

high TOX

high TOX

# Hulman Testing Results Continued

	<u>Oil &amp; Grease</u>	<u>TOC</u>	<u>TON</u>
#36 GS-12-1.5	0.04 %	2.1 %	120ug/g } break point
#37 GS-12-3.0	0.02 %	1.6 %	120ug/g }
#38 WS-4-7"	0.006%	24 ppm	12ppb
#39 WS-3-11"	0.002%	31 ppm	22ppb
#40 WS-9-10"	<i>very high</i> 1.1 %	46 ppm	30ppb
#41 WS-8-17"	0.003%	<i>high</i> 420 ppm	47ppb
#42 WS-2-9"	0.005%	104 ppm	28ppb
#43 WS-10-6"	<i>should be</i> 0.004%	<i>high</i> 1510 ppm	190ppb - additional inquiry
#44 WS-11-8 1/2"	<i>be</i> 0.003%	105 ppm	70ppb
#45 WS-13-16"	<i>serious</i> 0.001%	<i>high</i> 650 ppm	15ppb

ug/g - Micrograms/Gram  
ppm - Parts Per Million  
ppb - Parts Per Billion

↓  
0.01-.05  
should be for water

in soil  
no oil+grease  
considered  
to high

Respectfully submitted,

Dr. Robert Kent

revised SGPB  
cm

LABORATORY ANALYSIS REPORT AND RECORD (General)				DATE
		FROM: USAFOEHL/SA BROOKS AFB TX 78235-5501		20 Oct 86
SAMPLE IDENTITY WATER			DATE RECEIVED 10 Oct 86	
SAMPLE FROM			LAB CONTROL NR	
TEST FOR VOLATILE HALOCARBONS				
METHODOLOGY: EPA 601				
OEHL No.		70357	DET LIMIT	
BASE No.		6P360052		
Bromodichloromethane	32101	24.9		0.1
Bromoform	32104	7.6		0.2
Bromomethane	34413	ND		1.0
Carbon Tetrachloride	32102			0.1
Chlorobenzene	34301			0.2
Chloroethane	34311			0.5
2-Chloroethylvinyl ether	34576	✓		0.1
Chloroform	32106	38.3		0.1
Chloromethane	34418	ND		0.1
Dibromochloromethane	32105	21.4		0.1
1,2-Dichlorobenzene	34536	ND		0.2
1,3-Dichlorobenzene	34566			0.2
1,4-Dichlorobenzene	34571			0.2
Dichlorofluoromethane	34568			0.1
1,1-Dichloroethane	34496			0.2
1,2-Dichloroethane	34531			0.2
1,1-Dichloroethene	34501			0.1
trans 1,2-Dichloroethene	34546			0.1
1,2-Dichloropropane	34541			0.2
cis 1,3-Dichloropropene	34704			0.2
trans 1,3-Dichloropropene	34699			0.2
Methylene Chloride	34423			0.2
1,1,2,2-Tetrachloroethane	34516			0.1
Tetrachloroethylene	34475			0.1
1,1,1-Trichloroethane	34506			0.1
1,1,2-Trichloroethane	34511			0.1
Trichloroethylene	39180			0.1
Trichlorofluoromethane	34488			0.1
Vinyl Chloride	39175	✓		0.2
Results in micrograms per liter.				
ND = None Detected. Less than the detection Limit.				
TRACE = Present, but quantity less than quantitative limit.				
REQUESTING AGENCY (Mailing Address)			DATE ANALYZED: 17 + 20 Oct 86	
181 TAC CLINIC / SGPB HULMAN REGIONAL AIRPORT, TERRE HAUTE, IN 47803			A. Sanchez Be Harrison	
H-15				



ENVIRONMENTAL SAMPLING DATA (TRACE ORGANICS)				OEHL USE ONLY			
(Use this space for mechanical imprint)				SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PG 100</b>			
				BASE WHERE SAMPLE COLLECTED <b>Hulman Field IN ANG</b>			
				SAMPLING SITE DESCRIPTION <b>Underground Well Bldg 97</b>			
DATE COLLECTION BEGAN (YYMMDD) <b>6/6/10 10 17</b>		TIME COLLECTION BEGAN (24 hour clock) <b>0830</b>		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE _____ HOURS			
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345 81 TAL Clinic/SGPB, Hulman Regional Airport, Terre Haute IN 47603</b>					
	COPY 1						
	COPY 2						
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodward, E-7, 90770</b>				SIGNATURE <i>Charles W Woodward</i>		AUTOVON <b>724-1308</b>	
REASON FOR SUBMISSION <input checked="" type="checkbox"/> EK		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify) _____	
BASE SAMPLE NUMBER <b>6P 86 2053</b>				OEHL PID			
ANALYSES REQUESTED (check appropriate blocks)							
VOLATILE HALOCARBONS (VOH) (10860)		Trichlorofluoromethane 34488		MISCELLANEOUS			
PRES GROUP T1		Vinyl Chloride 39175		VOLATILES			
Volatile Halocarbon Screen 1001460PH				PRES GROUP T1			
Bromodichloromethane 32101				Xylene 81710			
Bromotorm 32104				Methylethyl ketone 81595			
Bromomethane 34413		TRISHALOMETHANES (THM) (10860)		Methylisobutyl ketone 81596			
Carbon Tetrachloride 32102		PRES GROUP T1		Total organic halides 10021060H			
Chlorobenzene 34301		Trihalomethane Potential 1001465MT					
Chloroethane 34311		Total Trihalomethanes 82080					
2,4-dichloroethylvinyl ether 34576							
Chlorotorm 32106		VOLATILE AROMATICS (VOA) (10850)					
Chloromethane 34418		PRES GROUP T1					
Dibromochloromethane 32105		Volatile Aromatic Screen 1001461PA					
1, 2-dichlorobenzene 34536		Benzene 34030		MISCELLANEOUS			
1, 3-dichlorobenzene 34566		Chlorobenzene 34301		EXTRACTABLES			
1, 4-dichlorobenzene 34571		1, 2-dichlorobenzene 34536		PRES GROUP T4			
Dichlorodifluoromethane 34668		1, 3-dichlorobenzene 34566		PCB's 39516			
1, 1-dichloroethane 34496		1, 4-dichlorobenzene 34571		Phthalate Esters Screen 1000069PH			
1, 2-dichloroethane 34531		Ethylbenzene 34371		bis (2-ethylhexyl) phthalate 39100			
1, 1-dichloroethene 34501		Toluene 34010		Butyl Benzyl phthalate 34292			
trans-1, 2-dichloroethene 34546				Di-n-butyl phthalate 39110			
1, 2-dichloropropane 34541				Diethyl phthalate 34336			
cis-1, 3-dichloropropene 34704				Dimethyl phthalate 34341			
trans-1, 3-dichloropropene 34699				Di-n-octyl phthalate 34596			
Methylene Chloride 34423							
1, 1, 2, 2-tetrachloroethane 34516							
Tetrachloroethylene 34475							
1, 1, 1-trichloroethane 34506							
1, 1, 2-trichloroethane 34511							
Trichloroethylene 39180							
REMARKS							



ENVIRONMENTAL SAMPLING DATA (TRACE ORGANICS)				OEHL USE ONLY			
(Use this space for mechanical imprint)				SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 P6 100</b>			
				BASE WHERE SAMPLE COLLECTED <b>Hulman Field IN ANG</b>			
				SAMPLING SITE DESCRIPTION <b>Underground Well Bldg 97</b>			
				COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE _____ HOURS			
DATE COLLECTION BEGAN (YYMMDD) <b>8/6/10</b>		TIME COLLECTION BEGAN (24 hour clock) <b>0830</b>					
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345 181 TAC Clinic/SGPB, Hulman Regional Airport, Terre Haute, IN 47803</b>					
	COPY 1						
	COPY 2						
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodward, E-7, 90770</b>				SIGNATURE <b>Charles Z Woodward</b>		AUTOVON <b>724-1308</b>	
REASON FOR SUBMISSION <input checked="" type="checkbox"/> EF		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify) _____	
BASE SAMPLE NUMBER <b>GP 86 0052</b>				OEHL PID			
ANALYSES REQUESTED (check appropriate blocks)							
VOLATILE HALOCARBONS (VOH) (10860)				Trichlorofluoromethane 34488		MISCELLANEOUS	
PRES GROUP T1				Vinyl Chloride 39175		VOLATILES	
<input checked="" type="checkbox"/> Volatile Halocarbon Screen 1001460PH						PRES GROUP T1	
Bromodichloromethane 32101						Xylene 81710	
Bromoform 32104						Methylethyl ketone 81595	
Bromomethane 34413				TRIHALOMETHANES (THM) (10860)		Methylisobutyl ketone 81596	
Carbon Tetrachloride 32102				PRES GROUP T1		Total organic halides 10021060H	
Chlorobenzene 34301				Trihalomethane Potential 1001465MT			
Chloroethane 34311				Total Trihalomethanes 82080			
2-Chloroethylvinyl ether 34576							
Chloroform 32106				VOLATILE AROMATICS (VOA) (10850)			
Chloromethane 34418				PRES GROUP T1			
Dibromochloromethane 32105				Volatile Aromatic Screen 1001461PA			
1, 2-dichlorobenzene 34536				Benzene 34030		MISCELLANEOUS	
1, 3-dichlorobenzene 34566				Chlorobenzene 34301		EXTRACTABLES	
1, 4-dichlorobenzene 34571				1, 2-dichlorobenzene 34536		PRES GROUP T4	
Dichlorodifluoromethane 34668				1, 3-dichlorobenzene 34566		PCB's 39516	
1, 1-dichloroethane 34496				1, 4-dichlorobenzene 34571		Phthalate Esters Screen 1000069PH	
1, 2-dichloroethane 34531				Ethylbenzene 34371		bis (2-ethylhexyl) phthalate 39100	
1, 1-dichloroethene 34501				Toluene 34010		Butyl Benzyl phthalate 34292	
trans-1, 2-dichloroethene 34546						Di-n-butyl phthalate 39110	
1, 2-dichloropropane 34541						Diethyl phthalate 34336	
cis-1, 3-dichloropropene 34704						Dimethyl phthalate 34341	
trans-1, 3-dichloropropene 34699						Di-n-octyl phthalate 34596	
Methylene Chloride 34423							
1, 1, 2, 2-tetrachloroethane 34516							
Tetrachloroethylene 34475							
1, 1, 1-trichloroethane 34506							
1, 1, 2-trichloroethane 34511							
Trichloroethylene 39180							
REMARKS							

ENVIRONMENTAL SAMPLING DATA (TRACE ORGANICS)					OEHL USE ONLY				
Use this space for mechanical imprints					SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 06 100</b> BASE WHERE SAMPLE COLLECTED <b>Hulman Field IN ANG</b> SAMPLING SITE DESCRIPTION <b>Underground Well Bldg 97</b>				
DATE COLLECTION BEGAN (YYMMDD) <b>8/6/04</b>		TIME COLLECTION BEGAN (24 hour clock) <b>0830</b>		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE _____ HOURS					
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345 81 TAC Clinic/SBPB, Hulman Regional Airport, Terre Haute IN 47803</b>							
	COPY 1								
	COPY 2								
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodworth, MSgt 90770</b>					SIGNATURE <i>Charles J Woodworth</i>			AUTOVON <b>724-1308</b>	
REASON FOR SUBMISSION <b>E2</b>		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify) _____			
BASE SAMPLE NUMBER <b>6P 86 0051</b>					OEHL PID				
ANALYSES REQUESTED (check appropriate blocks)									
VOLATILE HALOCARBONS (VOH) (10860)			Trichlorofluoromethane 34488			MISCELLANEOUS			
PRES GROUP T1			Vinyl Chloride 39175			VOLATILES			
Volatile Halocarbon Screen 1001460PH						PRES GROUP T1			
Bromodichloromethane 32101						Xylene 81710			
Bromotorm 32104						Methylethyl ketone 81595			
Bromomethane 34413			TRIHALOMETHANES (THM) (10860)			Methylisobutyl ketone 81596			
Carbon Tetrachloride 32102			PRES GROUP T1			Total organic halides 10021060H			
Chlorobenzene 34301			Trihalomethane Potential 1001465MT						
Chloroethane 34311			Total Trihalomethanes 82080						
2-Chloroethylvinyl ether 34576									
Chlorotorm 32106			VOLATILE AROMATICS (VOA) (10850)						
Chloromethane 34418			PRES GROUP T1						
Dibromochloromethane 32105			Volatile Aromatic Screen 1001461PA						
1, 2-dichlorobenzene 34536			Benzene 34030			MISCELLANEOUS			
1, 3-dichlorobenzene 34566			Chlorobenzene 34301			EXTRACTABLES			
1, 4-dichlorobenzene 34571			1, 2-dichlorobenzene 34536			PRES GROUP T4			
Dichlorodifluoromethane 34668			1, 3-dichlorobenzene 34566			PCB's 39516			
1, 1-dichloroethane 34496			1, 4-dichlorobenzene 34571			Phthalate Esters Screen 1000069PH			
1, 2-dichloroethane 34531			Ethylbenzene 34371			bis (2-ethylhexyl) phthalate 39100			
1, 1-dichloroethene 34501			Toluene 34010			Butyl Benzyl phthalate 34292			
trans-1, 2-dichloroethene 34546						Di-n-butyl phthalate 39110			
1, 2-dichloropropane 34541						Diethyl phthalate 34336			
cis-1, 3-dichloropropene 34704						Dimethyl phthalate 34341			
trans-1, 3-dichloropropene 34699						Di-n-octyl phthalate 34596			
Methylene Chloride 34423									
1, 1, 2, 2-tetrachloroethane 34516									
Tetrachloroethylene 34475									
1, 1, 1-trichloroethane 34506									
1, 1, 2-trichloroethane 34511									
Trichloroethylene 39180									
REMARKS									

ENVIRONMENTAL SAMPLING DATA (TRACE ORGANICS)				OEHL USE ONLY			
Use this space for mechanical imprints				SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PG 100</b>			
				BASE WHERE SAMPLE COLLECTED <b>Halman Field IN ANG</b>			
				SAMPLING SITE DESCRIPTION <b>Underground Well Bldg 97</b>			
DATE COLLECTION BEGAN (YYMMDD)		TIME COLLECTION BEGAN (24 hour clock)		COLLECTION METHOD			
<b>6/10/81 1217</b>		<b>0830</b>		<input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE _____ HOURS			
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345 81TAC Clinic/SLPB, Halman Regional Airport, Terre Haute IN 47803</b>					
	COPY 1						
	COPY 2						
SAMPLE COLLECTED BY (Name, Grade, AFSC)				SIGNATURE		AUTOVON	
<b>C Woodworth, E-7, 90770</b>				<b>Charles W Woodworth</b>		<b>724-1308</b>	
REASON FOR SUBMISSION		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify) _____	
<input checked="" type="checkbox"/> EK							
BASE SAMPLE NUMBER				OEHL PID			
<b>6P 86 0052</b>							
ANALYSES REQUESTED (check appropriate blocks)							
VOLATILE HALOCARBONS (VOH) (10860)		Trichlorofluoromethane 34488		MISCELLANEOUS			
PRES GROUP T1		Vinyl Chloride 39175		VOLATILES			
<input checked="" type="checkbox"/> Volatile Halocarbon Screen 1001460PH				PRES GROUP T1			
Bromodichloromethane 32101				Xylene 81710			
Bromoform 32104				Methylethyl ketone 81595			
Bromomethane 34413		TRIHALOMETHANES (THM) (10860)		Methylisobutyl ketone 81596			
Carbon Tetrachloride 32102		PRES GROUP T1		Total organic halides 10021060H			
Chlorobenzene 34301		Trihalomethane Potential 1001465MT					
Chloroethane 34311		Total Trihalomethanes 82080					
2-Chloroethylvinyl ether 34576							
Chloroform 32106		VOLATILE AROMATICS (VOA) (10850)					
Chloromethane 34418		PRES GROUP T1					
Dibromochloromethane 32105		Volatile Aromatic Screen 1001461PA					
1, 2-dichlorobenzene 34536		Benzene 34030		MISCELLANEOUS			
1, 3-dichlorobenzene 34566		Chlorobenzene 34301		EXTRACTABLES			
1, 4-dichlorobenzene 34571		1, 2-dichlorobenzene 34536		PRES GROUP T4			
Dichlorodifluoromethane 34668		1, 3-dichlorobenzene 34566		PCB'S 39516			
1, 1-dichloroethane 34496		1, 4-dichlorobenzene 34571		Phthalate Esters Screen 1000069PH			
1, 2-dichloroethane 34531		Ethylbenzene 34371		bis (2-ethylhexyl) phthalate 39100			
1, 1-dichloroethene 34501		Toluene 34010		Butyl Benzyl phthalate 34292			
trans-1, 2-dichloroethene 34546				Di-n-butyl phthalate 39110			
1, 2-dichloropropane 34541				Diethyl phthalate 34336			
cis-1, 3-dichloropropene 34704				Dimethyl phthalate 34341			
trans-1, 3-dichloropropene 34699				Di-n-octyl phthalate 34596			
Methylene Chloride 34423							
1, 1, 2, 2-tetrachloroethane 34516							
Tetrachloroethylene 34475							
1, 1, 1-trichloroethane 34506							
1, 1, 2-trichloroethane 34511							
Trichloroethylene 39180							
REMARKS							

ENVIRONMENTAL SAMPLING DATA (TRACE ORGANICS)				OEHL USE ONLY			
Use this space for mechanical imprint				SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PG 100</b>			
				BASE WHERE SAMPLE COLLECTED <b>Hulman Field IN ANG</b>			
				SAMPLING SITE DESCRIPTION <b>Underground Well Bldg 97</b>			
DATE COLLECTION BEGAN (YYMMDD) <b>86 10 8 12 17</b>		TIME COLLECTION BEGAN (24 hour clock) <b>0830</b>		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE _____ HOURS			
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345 81 TAC Clinic/SGPB, Hulman Regional Airport, Terre Haute IN 47803</b>					
	COPY 1						
	COPY 2						
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodward, E-7, 90770</b>				SIGNATURE <b>Charles Z Woodward</b>		AUTOVON <b>724-1308</b>	
REASON FOR SUBMISSION <input checked="" type="checkbox"/> EP		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify) _____	
BASE SAMPLE NUMBER <b>6P 86 0453</b>				OEHL PID			
ANALYSES REQUESTED (check appropriate blocks)							
VOLATILE HALOCARBONS (VOH) (10860)		Trichlorofluoromethane 34488		MISCELLANEOUS			
PRES GROUP T1		Vinyl Chloride 39175		VOLATILES			
Volatile Halocarbon Screen 1001460PH				PRES GROUP T1			
Bromodichloromethane 32101				Xylene 81710			
Bromoform 32104				Methylethyl ketone 81595			
Bromomethane 34413		TRIHALOMETHANES (THM) (10860)		Methylisobutyl ketone 81596			
Carbon Tetrachloride 32102		PRES GROUP T1		Total organic halides 10021060H			
Chlorobenzene 34301		Trihalomethane Potential 1001465MT					
Chloroethane 34311		Total Trihalomethanes 82080					
2-Chloroethylvinyl ether 34576							
Chloroform 32106		VOLATILE AROMATICS (VOA) (10850)					
Chloromethane 34418		PRES GROUP T1					
Dibromochloromethane 32105		Volatile Aromatic Screen 1001461PA					
1, 2-dichlorobenzene 34536		Benzene 34030		MISCELLANEOUS			
1, 3-dichlorobenzene 34566		Chlorobenzene 34301		EXTRACTABLES			
1, 4-dichlorobenzene 34571		1, 2-dichlorobenzene 34536		PRES GROUP T4			
Dichlorodifluoromethane 34668		1, 3-dichlorobenzene 34566		PCB's 39516			
1, 1-dichloroethane 34496		1, 4-dichlorobenzene 34571		Phthalate Esters Screen 1000069PH			
1, 2-dichloroethane 34531		Ethylbenzene 34371		bis (2-ethylhexyl) phthalate 39100			
1, 1-dichloroethene 34501		Toluene 34010		Butyl Benzyl phthalate 34292			
trans-1, 2-dichloroethene 34546				Di-n-butyl phthalate 39110			
1, 2-dichloropropane 34541				Diethyl phthalate 34336			
cis-1, 3-dichloropropene 34704				Dimethyl phthalate 34341			
trans-1, 3-dichloropropene 34699				Di-n-octyl phthalate 34596			
Methylene Chloride 34423							
1, 1, 2, 2-tetrachloroethane 34516							
Tetrachloroethylene 34475							
1, 1, 1-trichloroethane 34506							
1, 1, 2-trichloroethane 34511							
Trichloroethylene 39180							
REMARKS							

ENVIRONMENTAL SAMPLING DATA					OSHL USE ONLY	
(Use this space for mechanical imprint)					SAMPLING SITE IDENTIFIER (AFR 19-7)	
					0345 PG 100	
					BASE WHERE SAMPLE COLLECTED 181 TFG, Hulman Field IN	
					SAMPLING SITE DESCRIPTION Underground well, Bldg 97	
DATE COLLECTION BEGAN (YYMMDD) 8161011019		TIME COLLECTION BEGAN (24 hour clock)		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE 1430 HOURS		
MAIL REPORTS TO (circle if changed)	ORIGINAL	0345	181 TAC Clinic / 56PB, Hulman Regional Airport, Terre Haute IN 47803			
	COPY 1					
	COPY 2					
SAMPLE COLLECTED BY (Name, Grade, AFSC) C Woodward TSgt 90770					SIGNATURE Charles W Woodward	
					AUTOVON 724-1308	
REASON FOR SUBMISSION		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify)
BASE SAMPLE NUMBER		GP 86 0001		DEMO ID		
ANALYSES REQUESTED (Check appropriate blocks)						
GROUP A		Hardness 00900		Silica 00955		2, 4, 5-T 39740
Ammonia 00610		Iron 01045		Specific Conductance 00095		2, 4, 5-TP-Silvex 39760
Chemical Oxygen Demand 00340		Lead 01051		Sulfate 00945		
Kjeldahl Nitrogen 00625		Magnesium 00927		Surfactants-MBAS 38260		
<input checked="" type="checkbox"/> Nitrate 00620		Manganese 01055		Turbidity 00076		
<input checked="" type="checkbox"/> Nitrite 00615		Mercury 71900				
Oil & Grease 00560		Nickel 01067				
Organic Carbon 00680		Potassium 00937				
Orthophosphate 00671		Selenium 01147		GROUP H		
Phosphorus, Total 00665		Silver 01077		Aldrin 39330		
		Sodium 00929		BHC Isomers 39340		
GROUP D		Thallium 01059		a-BHC 39337		
Cyanide, Total 00720		Zinc 01092		b-BHC 39338		
Cyanide, Free 00722				d-BHC 34259		
				Chlordane 39350		GROUP I
GROUP E		GROUP G		DDT Isomers 39370		Sulfides 00745
Phenols 32730		Acidity, Total 70508		p, p-DDD 39310		
		Alkalinity, Total 00410		p, p-DDE 39320		
GROUP F		Alkalinity, Bicarbonate 00425		p, p-DDT 39300		
Antimony 01097		Bromide 71870		Dieldrin 39380		ON SITE ANALYSES
Arsenic 01002		Carbon Dioxide 00405		Dursban 77969		PARAMETER VALUE
Barium 01007		Chloride 00940		Endrin 39390		Flow 50050 mgd
Beryllium 01012		Color 00080		Heptachlor 39410		Chlorine, Total 50060 0 mg/l
Boron 01022		Fluoride 00951		Heptachlor Epoxide 39420		Dissolved Oxygen 00300 mg/l
Cadmium 01027		Residue, Total 00500		Lindane 39782		pH 00400 7.0 units
Calcium 00916		Residue, Filterable (TDS) 70300		Methoxychlor 39480		Temperature 00010 1.6 °C
Chromium, Total 01034		Residue, Nonfilterable 00530		Pramitol (Prameton) XY4200000		Odor 00086
Chromium VI 01032		Residue, Settleable 50085		Toxaphene 39400		Iodide 71865
Copper 01042		Residue, Volatile 00505		2, 4-D 39730		Sulfite 00740
REMARKS						



ENVIRONMENTAL SAMPLING DATA										OEHL USE ONLY									
(Use this space for mechanical imprint)										SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PG 100</b>									
										BASE WHERE SAMPLE COLLECTED <b>181 TFG, Halman Field IN</b>									
										SAMPLING SITE DESCRIPTION <b>Underground well, Bldg. 47</b>									
DATE COLLECTION BEGAN (YYMMDD) <b>81 6 01 019</b>					TIME COLLECTION BEGAN (24 hour clock)					COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE <b>1430</b> HOURS									
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345</b>				<b>181 TAC Clinic/SGPB, Halman Regional Airport, Terre Haute IN 47803</b>													
	COPY 1																		
	COPY 2																		
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodworth TSgt 90770</b>										SIGNATURE <i>Charles H Woodworth</i>					AUTOVON <b>724-1308</b>				
REASON FOR SUBMISSION		<b>EK</b>		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC			C-COMPLAINT N-NPDES			F-FOLLOWUP/CLEANUP O-OTHER (specify) _____									
BASE SAMPLE NUMBER					<b>GP 86 0002</b>					OEHL PID									
ANALYSES REQUESTED (Check appropriate blocks)																			
GROUP A					Hardness 00900					Silica 00955					2, 4, 5-T 39740				
Ammonia 00610					Iron 01045					Specific Conductance 00095					2, 4, 5-TP-Silvex 39760				
Chemical Oxygen Demand 00340					Lead 01051					Sulfate 00945									
Kjeldahl Nitrogen 00625					Magnesium 00927					Surfactants-MBAS 38260									
Nitrate 00620					Manganese 01055					Turbidity 00076									
Nitrite 00615					Mercury 71900														
<input checked="" type="checkbox"/> Oil & Grease 00560					Nickel 01067														
Organic Carbon 00680					Potassium 00937														
Orthophosphate 00671					Selenium 01147					GROUP H									
Phosphorus, Total 00665					Silver 01077					Aldrin 39330									
					Sodium 00929					BHC Isomers 39340									
GROUP D					Thallium 01059					a-BHC 39337									
Cyanide, Total 00720					Zinc 01092					b-BHC 39338									
Cyanide, Free 00722										d-BHC 34259									
										Chlordane 39350					GROUP J				
GROUP E					GROUP G					DDT Isomers 39370					Sulfides 00745				
Phenols 32730					Acidity, Total 70508					p, p-DDD 39310									
					Alkalinity, Total 00410					p, p-DDE 39320									
GROUP F					Alkalinity, Bicarbonate 00425					p, p-DDT 39300									
Antimony 01097					Bromide 71870					Dieldrin 39380					ON SITE ANALYSES				
Arsenic 01002					Carbon Dioxide 00405					Dursban 77969									
Barium 01007					Chloride 00940					Endrin 39390					Flow	50050	-	mgd	
Beryllium 01012					Color 00080					Heptachlor 39410					Chlorine, Total	50060	0	mg/l	
Boron 01022					Fluoride 00951					Heptachlor Epoxide 39420					Dissolved Oxygen	00300	-	mg/l	
Cadmium 01027					Residue, Total 00500					Lindane 39782					pH	00400	7	units	
Calcium 00916					Residue, Filterable (TDS) 70300					Methoxychlor 39480					Temperature	00010	1.6	°C	
Chromium, Total 01034					Residue, Nonfilterable 00530					Pramitol (Prameton) XY4200000					Odor	00086	-		
Chromium VI 01032					Residue, Settleable 50085					Toxaphene 39400					Iodide	71865	-		
Copper 01042					Residue, Volatile 00505					2, 4-D 39730					Sulfite	00740	-		
REMARKS																			

ENVIRONMENTAL SAMPLING DATA					OEHL USE ONLY																		
(Use this space for mechanical imprint)					SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PG 100</b>																		
					BASE WHERE SAMPLE COLLECTED <b>181 TFG Hulman Field IN</b>																		
					SAMPLING SITE DESCRIPTION <b>Underground Well Bldg. 97</b>																		
DATE COLLECTION BEGAN (YYMMDD) <b>8161011019</b>		TIME COLLECTION BEGAN (24 hour clock)		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE <b>1430 HOURS</b>																			
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345</b>		<b>181 TAL Clinic / 566A, Hulman Regional Airport, Terre Haute IN 47803</b>																			
	COPY 1																						
	COPY 2																						
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodworth, TSgt 90770</b>				SIGNATURE <b>Charles Z. Z...</b>																			
REASON FOR SUBMISSION <input checked="" type="checkbox"/> ER		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES																			
				F-FOLLOWUP/CLEANUP O-OTHER (specify)																			
BASE SAMPLE NUMBER <b>GP 86 0003</b>		OEHL PID																					
ANALYSES REQUESTED (Check appropriate blocks)																							
GROUP A		Hardness 00900		Silica 00955 2, 4, 5-T 39740																			
Ammonia 00610		Iron 01045		Specific Conductance 00095 2, 4, 5-TP-Silvex 39760																			
Chemical Oxygen Demand 00340		Lead 01051		Sulfate 00945																			
Kjeldahl Nitrogen 00625		Magnesium 00927		Surfactants-MBAS 38260																			
Nitrate 00620		Manganese 01055		Turbidity 00076																			
Nitrite 00615		Mercury 71900																					
Oil & Grease 00560		Nickel 01067																					
Organic Carbon 00680		Potassium 00937																					
Orthophosphate 00671		Selenium 01147		GROUP H																			
Phosphorus, Total 00665		Silver 01077		Aldrin 39330																			
		Sodium 00929		BHC Isomers 39340																			
GROUP D		Thallium 01059		a-BHC 39337																			
<input checked="" type="checkbox"/> Cyanide, Total 00720		Zinc 01092		b-BHC 39338																			
Cyanide, Free 00722				d-BHC 34259																			
				Chlordane 39350																			
GROUP E		GROUP G		GROUP J																			
Phenols 32730		Acidity, Total 70508		DDT Isomers 39370 Sulfides 00745																			
		Alkalinity, Total 00410		p, p-DDD 39310																			
		Alkalinity, Bicarbonate 00425		p, p-DDE 39320																			
				p, p-DDT 39300																			
Antimony 01097		Bromide 71870		Dieldrin 39380																			
Arsenic 01002		Carbon Dioxide 00405		Dursban 77969																			
Barium 01007		Chloride 00940		Endrin 39390																			
Beryllium 01012		Color 00080		Heptachlor 39410																			
Boron 01022		Fluoride 00951		Heptachlor Epoxide 39420																			
Cadmium 01027		Residue, Total 00500		Lindane 39782																			
Calcium 00916		Residue, Filterable (TDS) 70300		Methoxychlor 39480																			
Chromium, Total 01034		Residue, Nonfilterable 00530		Pramitol (Prometon) XY4200000																			
Chromium VI 01032		Residue, Settleable 50085		Toxaphene 39400																			
Copper 01042		Residue, Volatile 00505		2, 4-D 39730																			
ON SITE ANALYSES																							
				<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th>PARAMETER</th> <th>VALUE</th> </tr> </thead> <tbody> <tr> <td>Flow</td> <td>50050 — mgd</td> </tr> <tr> <td>Chlorine, Total</td> <td>50060 0 mg/l</td> </tr> <tr> <td>Dissolved Oxygen</td> <td>00300 — mg/l</td> </tr> <tr> <td>pH</td> <td>00400 7 units</td> </tr> <tr> <td>Temperature</td> <td>00010 1.6 °C</td> </tr> <tr> <td>Odor</td> <td>00086 —</td> </tr> <tr> <td>Iodide</td> <td>71865 —</td> </tr> <tr> <td>Sulfite</td> <td>00740 —</td> </tr> </tbody> </table>		PARAMETER	VALUE	Flow	50050 — mgd	Chlorine, Total	50060 0 mg/l	Dissolved Oxygen	00300 — mg/l	pH	00400 7 units	Temperature	00010 1.6 °C	Odor	00086 —	Iodide	71865 —	Sulfite	00740 —
PARAMETER	VALUE																						
Flow	50050 — mgd																						
Chlorine, Total	50060 0 mg/l																						
Dissolved Oxygen	00300 — mg/l																						
pH	00400 7 units																						
Temperature	00010 1.6 °C																						
Odor	00086 —																						
Iodide	71865 —																						
Sulfite	00740 —																						

REMARKS

ENVIRONMENTAL SAMPLING DATA				OEHL USE ONLY			
(Use this space for mechanical imprint)				SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 P6</b> <b>10</b>			
				BASE WHERE SAMPLE COLLECTED <b>181 TFG Hulman Field IN</b>			
				SAMPLING SITE DESCRIPTION <b>Underground well Bldg. 97</b>			
DATE COLLECTION BEGAN (YYMMDD) <b>8/6/01</b>		TIME COLLECTION BEGAN (24 hour clock) <b>09</b>		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE <b>1430 HOURS</b>			
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345</b>		<b>181 TAC Clinic/SLPB, Hulman Regional Airport Terre Haute IN 47803</b>			
	COPY 1						
	COPY 2						
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodward TSgt 90770</b>				SIGNATURE <i>Charles Woodward</i>		AUTOVON <b>724-1308</b>	
REASON FOR SUBMISSION		<input checked="" type="checkbox"/> A-ACCIDENT/INCIDENT <input type="checkbox"/> R-ROUTINE/PERIODIC		<input type="checkbox"/> C-COMPLAINT <input type="checkbox"/> N-NPDES		<input type="checkbox"/> F-FOLLOWUP/CLEANUP <input type="checkbox"/> O-OTHER (specify)	
BASE SAMPLE NUMBER		<b>GP 86 0004</b>		OEHL PID			
ANALYSES REQUESTED (Check appropriate blocks)							
GROUP A		Hardness 00900		Silica 00955		2, 4, 5-T 39740	
Ammonia 00610		Iron 01045		Specific Conductance 00095		2, 4, 5-TP-Silvex 39760	
Chemical Oxygen Demand 00340		Lead 01051		Sulfate 00945			
Kjeldahl Nitrogen 00625		Magnesium 00927		Surfactants-MBAS 38260			
Nitrate 00620		Manganese 01055		Turbidity 00076			
Nitrite 00615		Mercury 71900					
Oil & Grease 00560		Nickel 01067					
Organic Carbon 00680		Potassium 00937					
Orthophosphate 00671		Selenium 01147		GROUP H			
Phosphorus, Total 00665		Silver 01077		Aldrin 39330			
		Sodium 00929		BHC Isomers 39340			
GROUP D		Thallium 01059		a-BHC 39337			
Cyanide, Total 00720		Zinc 01092		b-BHC 39338			
Cyanide, Free 00722				d-BHC 34259			
				Chlordane 39350		GROUP J	
GROUP E		GROUP G		DDT Isomers 39370		Sulfides 00745	
<input checked="" type="checkbox"/> Phenols 32730		Acidity, Total 70508		p, p-DDD 39310			
		Alkalinity, Total 00410		p, p-DDE 39320			
GROUP F		Alkalinity, Bicarbonate 00425		p, p-DDT 39300			
Antimony 01097		Bromide 71870		Dieldrin 39380		ON SITE ANALYSES	
Arsenic 01002		Carbon Dioxide 00405		Dursban 77969			
Barium 01007		Chloride 00940		Endrin 39390		Flow 50050	— mgd
Beryllium 01012		Color 00080		Heptachlor 39410		Chlorine, Total 50060	0 mg/l
Boron 01022		Fluoride 00951		Heptachlor Epoxide 39420		Dissolved Oxygen 00300	— mg/l
Cadmium 01027		Residue, Total 00500		Lindane 39782		pH 00400	7 units
Calcium 00916		Residue, Filterable (TDS) 70300		Methoxychlor 39480		Temperature 00010	1.6 °C
Chromium, Total 01034		Residue, Nonfilterable 00530		Pramitol (Pramaton) XY4200000		Odor 00086	—
Chromium VI 01032		Residue, Settleable 50085		Toxaphene 39400		Iodide 71865	—
Copper 01042		Residue, Volatile 00505		2, 4-D 39730		Sulfite 00740	—
REMARKS							



ENVIRONMENTAL SAMPLING DATA										OEHL USE ONLY														
(Use this space for mechanical imprint)										SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PG 100</b>														
										BASE WHERE SAMPLE COLLECTED <b>181 TFG Hulman Field IN</b>														
										SAMPLING SITE DESCRIPTION <b>Underground well Bldg 97</b>														
DATE COLLECTION BEGAN (YYMMDD) <b>8/6/01</b>					TIME COLLECTION BEGAN (24 hour clock) <b>09</b>					COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE <b>1430</b> HOURS														
MAIL REPORTS TO (circle if changed)	ORIGINAL		<b>0345</b>		<b>181 TAC Clinic/SGPB, Hulman Regional Airport, Terre Haute IN 47803</b>																			
	COPY 1																							
	COPY 2																							
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodworth TSgt 90770</b>										SIGNATURE <i>Charles H Woodworth</i>					AUTOVON <b>724-1308</b>									
REASON FOR SUBMISSION		<input checked="" type="checkbox"/> A-ACCIDENT/INCIDENT <input type="checkbox"/> R-ROUTINE/PERIODIC <input type="checkbox"/> C-COMPLAINT N-NPDES <input type="checkbox"/> F-FOLLOWUP/CLEANUP O-OTHER (specify)																						
BASE SAMPLE NUMBER					<b>GP 86 0005</b>					OEHL PID														
ANALYSES REQUESTED (Check appropriate blocks)																								
GROUP A					<input checked="" type="checkbox"/> Hardness 00900					Silica 00955					2, 4, 5-T 39740									
Ammonia 00610					<input checked="" type="checkbox"/> Iron 01045					Specific Conductance 00095					2, 4, 5-TP-Silvex 39760									
Chemical Oxygen Demand 00340					<input checked="" type="checkbox"/> Lead 01051					Sulfate 00945														
Kjeldahl Nitrogen 00625					Magnesium 00927					Surfactants-MBAS 38260														
Nitrate 00620					<input checked="" type="checkbox"/> Manganese 01055					Turbidity 00076														
Nitrite 00615					<input checked="" type="checkbox"/> Mercury 71900																			
Oil & Grease 00560					<input checked="" type="checkbox"/> Nickel 01067																			
Organic Carbon 00680					Potassium 00937																			
Orthophosphate 00671					<input checked="" type="checkbox"/> Selenium 01147					GROUP H														
Phosphorus, Total 00665					<input checked="" type="checkbox"/> Silver 01077					Aldrin 39330														
					Sodium 00929					BHC Isomers 39340														
GROUP D					Thallium 01059					a-BHC 39337														
Cyanide, Total 00720					<input checked="" type="checkbox"/> Zinc 01092					b-BHC 39338														
Cyanide, Free 00722										d-BHC 34259														
										Chlordane 39350					GROUP J									
GROUP E					GROUP G					DDT Isomers 39370					Sulfides 00745									
Phenols 32730					Acidity, Total 70508					p, p-DDD 39310														
					Alkalinity, Total 00410					p, p-DDE 39320														
GROUP F					Alkalinity, Bicarbonate 00425					p, p-DDT 39300														
Antimony 01097					Bromide 71870					Dieldrin 39380					ON SITE ANALYSES									
<input checked="" type="checkbox"/> Arsenic 01002					Carbon Dioxide 00405					Dursban 77969														
<input checked="" type="checkbox"/> Barium 01007					Chloride 00940					Endrin 39390					Flow 50050		mgd							
Beryllium 01012					Color 00080					Heptachlor 39410					Chlorine, Total 50060		mg/l							
Boron 01022					Fluoride 00951					Heptachlor Epoxide 39420					Dissolved Oxygen 00300		mg/l							
<input checked="" type="checkbox"/> Cadmium 01027					Residue, Total 00500					Lindane 39782					pH 00400		units							
Calcium 00916					Residue, Filterable (TDS) 70300					Methoxychlor 39480					Temperature 00010		1.6 °C							
<input checked="" type="checkbox"/> Chromium, Total 01034					Residue, Nonfilterable 00530					Pramitol (Pramaton) XY4200000					Odor 00086									
Chromium VI 01032					Residue, Settleable 50085					Toxaphene 39400					Iodide 71865									
<input checked="" type="checkbox"/> Copper 01042					Residue, Volatile 00505					2, 4-D 39730					Sulfite 00740									
REMARKS																								

ENVIRONMENTAL SAMPLING DATA				OEHL USE ONLY	
(Use this space for mechanical imprint)				SAMPLING SITE IDENTIFIER (AFR 19.7) <b>0345 PG 100</b>	
				BASE WHERE SAMPLE COLLECTED <b>181 TFG Hulman Field IN</b>	
				SAMPLING SITE DESCRIPTION <b>Underground well Bldg 97</b>	
DATE COLLECTION BEGAN (YYMMDD) <b>8/6/01/019</b>		TIME COLLECTION BEGAN (24 hour clock)		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE <b>1430 HOURS</b>	
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345</b>	<b>181 TAC Chair/SGRB, Hulman Regional Airport, Terre Haute IN 47803</b>		
	COPY 1				
	COPY 2				
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodward TSgt 90770</b>				SIGNATURE <i>Charles J Woodward</i>	
REASON FOR SUBMISSION <input checked="" type="checkbox"/> A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC				C-COMPLAINT N-NPDES F-FOLLOWUP/CLEANUP O-OTHER (specify)	
BASE SAMPLE NUMBER		<b>GP 86 0006</b>		OEHL PID	
ANALYSES REQUESTED (Check appropriate blocks)					
GROUP A		Hardness	00900	Silica	00955
Ammonia 00610		Iron	01045	Specific Conductance	00095
Chemical Oxygen Demand 00340		Lead	01051	<input checked="" type="checkbox"/> Sulfate	00945
Kjeldahl Nitrogen 00625		Magnesium	00927	Surfactants-MBAS	38260
Nitrate 00620		Manganese	01055	<input checked="" type="checkbox"/> Turbidity	00076
Nitrite 00615		Mercury	71900		
Oil & Grease 00560		Nickel	01067		
Organic Carbon 00680		Potassium	00937		
Orthophosphate 00671		Selenium	01147	GROUP H	
Phosphorus, Total 00665		Silver	01077	Aldrin	39330
		Sodium	00929	BHC Isomers	39340
GROUP D		Thallium	01059	a-BHC	39337
Cyanide, Total 00720		Zinc	01092	b-BHC	39338
Cyanide, Free 00722				d-BHC	34259
				Chlordane	39350
GROUP E		GROUP G		DDT Isomers	39370
Phenols 32730		Acidity, Total	70508	p, p-DDD	39310
		Alkalinity, Total	00410	p, p-DDE	39320
GROUP F		Alkalinity, Bicarbonate	00425	p, p-DDT	39300
Antimony 01097		Bromide	71870	Dieldrin	39380
Arsenic 01002		Carbon Dioxide	00405	Dursban	77969
Barium 01007		Chloride	00940	Endrin	39390
Beryllium 01012		Color	00080	Heptachlor	39410
Boron 01022		Fluoride	00951	Heptachlor Epoxide	39420
Cadmium 01027		Residue, Total	00500	Lindane	39782
Calcium 00916		Residue, Filterable (TDS)	70300	Methoxychlor	39480
Chromium, Total 01034		Residue, Nonfilterable	00530	Pramitol (Prometon)	XY4200000
Chromium VI 01032		Residue, Settleable	50085	Toxaphene	39400
Copper 01042		Residue, Volatile	00505	2, 4-D	39730
ON SITE ANALYSES					
				PARAMETER	VALUE
				Flow	50050 — mgd
				Chlorine, Total	50060 0 mg/l
				Dissolved Oxygen	00300 — mg/l
				pH	00400 7 units
				Temperature	00010 1.6 °C
				Odor	00086 —
				Iodide	71865 —
				Sulfite	00740 —
REMARKS					

ENVIRONMENTAL SAMPLING DATA				OEHL USE ONLY			
(Use this space for mechanical imprint)				SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PG 100</b>			
				BASE WHERE SAMPLE COLLECTED <b>181 TFG Hulman Field IN</b>			
				SAMPLING SITE DESCRIPTION <b>Underground Well Bldg 97</b>			
DATE COLLECTION BEGAN (YYMMDD) <b>8161011019</b>		TIME COLLECTION BEGAN (24 hour clock)		COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE <b>1430</b> HOURS			
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345</b>	<b>181 TAC Clinic / 56PB, Hulman Regional Airport, Terre Haute IN 47603</b>				
	COPY 1						
	COPY 2						
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodworth TSgt 90770</b>				SIGNATURE <i>Charles J Woodworth</i>		AUTOVON <b>724-1308</b>	
REASON FOR SUBMISSION <input checked="" type="checkbox"/> EK		A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify)	
BASE SAMPLE NUMBER		<b>GP 86 0007</b>		OEHL ID			
ANALYSES REQUESTED (Check appropriate blocks)							
<input checked="" type="checkbox"/> GROUP A		Hardness 00900		<input checked="" type="checkbox"/> Silica 00955		<input checked="" type="checkbox"/> 2, 4, 5-T 39740	
<input type="checkbox"/> Ammonia 00610		<input type="checkbox"/> Iron 01045		<input checked="" type="checkbox"/> Specific Conductance 00095		<input checked="" type="checkbox"/> 2, 4, 5-TP-Silvex 39760	
<input type="checkbox"/> Chemical Oxygen Demand 00340		<input type="checkbox"/> Lead 01051		<input type="checkbox"/> Sulfate 00945			
<input type="checkbox"/> Kjeldahl Nitrogen 00625		<input type="checkbox"/> Magnesium 00927		<input type="checkbox"/> Surfactants-MBAS 38260			
<input type="checkbox"/> Nitrate 00620		<input type="checkbox"/> Manganese 01055		<input type="checkbox"/> Turbidity 00076			
<input type="checkbox"/> Nitrite 00615		<input type="checkbox"/> Mercury 71900					
<input type="checkbox"/> Oil & Grease 00560		<input type="checkbox"/> Nickel 01067					
<input type="checkbox"/> Organic Carbon 00680		<input type="checkbox"/> Potassium 00937					
<input type="checkbox"/> Orthophosphate 00671		<input type="checkbox"/> Selenium 01147		<input type="checkbox"/> GROUP H			
<input type="checkbox"/> Phosphorus, Total 00665		<input type="checkbox"/> Silver 01077		<input type="checkbox"/> Aldrin 39330			
		<input type="checkbox"/> Sodium 00929		<input type="checkbox"/> BHC Isomers 39340			
<input type="checkbox"/> GROUP D		<input type="checkbox"/> Thallium 01059		<input type="checkbox"/> a-BHC 39337			
<input type="checkbox"/> Cyanide, Total 00720		<input type="checkbox"/> Zinc 01092		<input type="checkbox"/> b-BHC 39338			
<input type="checkbox"/> Cyanide, Free 00722				<input type="checkbox"/> d-BHC 34259			
				<input checked="" type="checkbox"/> Chlordane 39350		<input type="checkbox"/> GROUP J	
<input type="checkbox"/> GROUP E		<input type="checkbox"/> GROUP G		<input checked="" type="checkbox"/> DDT Isomers 39370		<input type="checkbox"/> Sulfides 00745	
<input type="checkbox"/> Phenols 32730		<input type="checkbox"/> Acidity, Total 70508		<input type="checkbox"/> p, p-DDD 39310			
		<input type="checkbox"/> Alkalinity, Total 00410		<input type="checkbox"/> p, p-DDE 39320			
<input type="checkbox"/> GROUP F		<input type="checkbox"/> Alkalinity, Bicarbonate 00425		<input type="checkbox"/> p, p-DDT 39300			
<input type="checkbox"/> Antimony 01097		<input type="checkbox"/> Bromide 71870		<input checked="" type="checkbox"/> Dieldrin 39380		ON SITE ANALYSES	
<input type="checkbox"/> Arsenic 01002		<input type="checkbox"/> Carbon Dioxide 00405		<input type="checkbox"/> Dursban 77969			
<input type="checkbox"/> Barium 01007		<input type="checkbox"/> Chloride 00940		<input checked="" type="checkbox"/> Endrin 39390		Flow	50050 — mgd
<input type="checkbox"/> Beryllium 01012		<input type="checkbox"/> Color 00080		<input type="checkbox"/> Heptachlor 39410		Chlorine, Total	50060 0 mg/l
<input type="checkbox"/> Boron 01022		<input type="checkbox"/> Fluoride 00951		<input type="checkbox"/> Heptachlor Epoxide 39420		Dissolved Oxygen	00300 — mg/l
<input type="checkbox"/> Cadmium 01027		<input type="checkbox"/> Residue, Total 00500		<input checked="" type="checkbox"/> Lindane 39782		pH	00400 7 units
<input type="checkbox"/> Calcium 00916		<input type="checkbox"/> Residue, Filterable (TDS) 70300		<input checked="" type="checkbox"/> Methoxychlor 39480		Temperature	00010 1.6 °C
<input type="checkbox"/> Chromium, Total 01034		<input type="checkbox"/> Residue, Nonfilterable 00530		<input type="checkbox"/> Pramitol (Prameton) XY4200000		Odor	00086 —
<input type="checkbox"/> Chromium VI 01032		<input type="checkbox"/> Residue, Settleable 50085		<input checked="" type="checkbox"/> Toxaphene 39400		Iodide	71865 —
<input type="checkbox"/> Copper 01042		<input type="checkbox"/> Residue, Volatile 00505		<input checked="" type="checkbox"/> 2, 4-D 39730		Sulfite	00740 —
REMARKS							

0120

2. LABORATORY PERFORMING ANALYSIS <b>OEHL</b>			3. LAB SAMPLE NUMBER <b>08873</b>			4. REQUESTOR SAMPLE NUMBER <b>GP860001</b>			
SAMPLE COLLECTION INFORMATION						5. DATE RECEIVED BY LAB <b>5 Feb. 86</b>		6. DATE ANALYSIS COMPLETED <b>19 Feb. 86</b>	
7. SITE DESCRIPTION						ON-SITE ANALYTICAL RESULTS			
8. SITE LOCATION NO		9. FLOWRATE AT SITE 00088 GAL/MIN		10. WEATHER 00041		11. WATER TEMP 000 10 °C		12. PH 00400 UNITS	
11. COLLECTION DATE/PERIOD				12. NAME OF COLLECTOR		13. RESULTS OF OTHER ON-SITE ANALYSES			
12. SAMPLING TECHNIQUE <b>FEB 5 11 34 AM '86</b>				14. PHONE NUMBER					
13. REASON FOR SAMPLE SUBMISSION									

ANALYSES REQUESTED AND RESULTS								
A. PRIMARY DRINKING WATER STANDARDS (40CFR 141)								
PRESERVATION GROUP F				PRESERVATION GROUP C <b>43</b>				
PARAMETER	TOTAL	µ G/L	MAX LEV ALLWD	PARAMETER	TOTAL	MG/L	MAX LEV ALLWD	
ARSENIC	01002	.	50 µ G/L	NITRATE AS N (Cadmium Reduction Method)	00620	0.18	10 MG/L	
BARIUM	01007	.	1000 µ G/L	PRESERVATION GROUP G				
CADMIUM	01027	.	10. µ G/L	FLUORIDE	00951	.	See table in AFR 161-44	
CHROMIUM	01034	.	50 µ G/L	TURBIDITY	00076	Units	1 Unit	
LEAD	01051	.	50 µ G/L					
MERCURY	71900	.	2 µ G/L	<i>Gepe nitrite</i>		<.02		
SELENIUM	01147	.	10 µ G/L					
SILVER	01077	.	50 µ G/L					
B. OTHER ANALYSES								
PRESERVATION GROUP F			PRESERVATION GROUP G					
PARAMETER	TOTAL	µ G/L	PARAMETER	TOTAL	MG/L	PARAMETER	TOTAL	MG/L
COPPER	01042	.	Acidity, Mineral As CaCO <sub>3</sub>	00436	.	Sulfate As SO <sub>4</sub>	00945	.
IRON	01045	.	Acidity, Total, As CaCO <sub>3</sub>	00435	.	Surfactants MBAS As LAS	38260	.
MANGANESE	01055	.	Alkalinity, Phenolphth As CaCO <sub>3</sub>	00415	.			
ZINC	01092	.	Alkalinity, Total, As CaCO <sub>3</sub>	00410	.			
CALCIUM As Ca	00916	mg/l	Chloride	00940	.			
MAGNESIUM As Mg	00927	mg/l	Hardness As CaCO <sub>3</sub>	00900	.	PRESERVATION GROUP J		
POTASSIUM	00937	mg/l	Residue, Filtrable (TDS)	00515	.	PARAMETER	TOTAL	MG/L
SODIUM	00929	mg/l	Residue, Non-Filtrable (SS)	00530	.			
			Residue	00500	.			
			Specific Conductance	00095	µmhos			

1. ORGANIZATION REQUESTING ANALYSIS  <b>Hulman Regional AIRPORT</b>		CHEMIST <b>PT</b>
		REVIEWED BY
		APPROVED BY <b>Daryl B. Bird</b>

H-29

1. LABORATORY PERFORMING ANALYSIS <div style="font-size: 1.5em; font-family: cursive;">DEHL</div>		3. LAB SAMPLE NUMBER <div style="font-size: 1.5em; font-family: cursive;">07875</div>		4. REQUESTOR SAMPLE NUMBER <div style="font-size: 1.5em; font-family: cursive;">GP860003</div>	
SAMPLE COLLECTION INFORMATION				5. DATE RECEIVED BY LAB <div style="font-size: 1.2em; font-family: cursive;">5 Feb. 86</div>	
7. SITE DESCRIPTION				6. DATE ANALYSIS COMPLETED <div style="font-size: 1.2em; font-family: cursive;">19 Feb. 86</div>	
				ON-SITE ANALYTICAL RESULTS	
8. SITE LOCATION/NO		9. FLOWRATE AT SITE <small>00000 GAL/MIN</small>		10. WEATHER <small>00061</small>	
11. COLLECTION DATE/PERIOD		12. NAME OF COLLECTOR		13. WATER TEMP <small>000 10 °C</small>	
12. SAMPLING TECHNIQUE <div style="font-size: 1.2em; font-family: cursive;">FEB 5 11 34 AM '86</div>		14. PHONE NUMBER		15. PM <small>00400 UNITS</small>	
15. REASON FOR SAMPLE SUBMISSION				16. DISS O <sub>2</sub> <small>00300 MG/L</small>	
17. RESULTS OF OTHER ON-SITE ANALYSES					

ANALYSES REQUESTED AND RESULTS							
A. PRIMARY DRINKING WATER STANDARDS (40CFR 141)							
PRESERVATION GROUP F				PRESERVATION GROUP C			
PARAMETER	TOTAL	µg/L	MAX LEV ALLOW	PARAMETER	TOTAL	MG/L	MAX LEV ALLOW
ARSENIC	01002		30 µg/L	NITRATE AS N (Cadmium Reduction Method)	00620		10 MG/L
BARIUM	01009		1000 µg/L				
CADMIUM	01027		10 µg/L				
CHROMIUM	01034		30 µg/L				
LEAD	01051		30 µg/L				
MERCURY	71900		2 µg/L				
SELENIUM	01147		10 µg/L				
SILVER	01077		30 µg/L				

PRESERVATION GROUP F				PRESERVATION GROUP G			
PARAMETER	TOTAL	µg/L		PARAMETER	TOTAL	MG/L	
COPPER	01042			Acidity, Mineral As CaCO <sub>3</sub>	00436		
IRON	01045			Acidity, Total, As CaCO <sub>3</sub>	00435		
MANGANESE	01055			Alkalinity, Phenolphth As CaCO <sub>3</sub>	00415		
ZINC	01092			Alkalinity, Total, As CaCO <sub>3</sub>	00410		
CALCIUM As Ca	00918			Chloride	00940		
MAGNESIUM As Mg	00927			Hardness As CaCO <sub>3</sub>	00900		
POTASSIUM	00937			Residue, Filtrable (TDS)	00515		
SODIUM	00929			Residue, Non-Filtrable (SS)	00530		
				Residue	00500		
				Specific Conductance	00095		

1. ORGANIZATION REQUESTING ANALYSIS <div style="font-size: 1.5em; font-family: cursive; text-align: center;">Hulman Regional AIRPORT</div>		CHEMIST <div style="font-size: 1.5em; font-family: cursive;">DB</div>	
		REVIEWED BY	
		APPROVED BY <div style="font-size: 1.5em; font-family: cursive;">D. J. D.</div>	



8.58

2. LABORATORY PERFORMING ANALYSIS <b>DEHL</b>			3. LAB SAMPLE NUMBER <b>07 876</b>		4. REQUESTOR SAMPLE NUMBER <b>GP860004</b>						
7. SITE DESCRIPTION					6. DATE RECEIVED BY LAB <b>5 Feb. 86</b>		8. DATE ANALYSIS COMPLETED <b>19 Feb. 86</b>				
					ON-SITE ANALYTICAL RESULTS						
9. SITE LOCATION NO		9. FLOWRATE AT SITE 00088 GAL/MIN		10. WEATHER 00041		16. WATER TEMP 000 10 °C		17. PH 00400 UNITS		18. DISS O <sub>2</sub> 00300 MG/L	
11. COLLECTION DATE/PERIOD				12. NAME OF COLLECTOR		19. RESULTS OF OTHER ON-SITE ANALYSES					
13. SAMPLING TECHNIQUE <b>FEB 5 11 34 AM '86</b>				14. PHONE NUMBER							
15. REASON FOR SAMPLE SUBMISSION											
ANALYSES REQUESTED AND RESULTS											
A. PRIMARY DRINKING WATER STANDARDS (40CFR 141)											
PRESERVATION GROUP F					PRESERVATION GROUP C						
PARAMETER	TOTAL	µG/L	MAX LEV ALLWD		PARAMETER	TOTAL	MG/L	MAX LEV ALLWD			
ARSENIC	01002		50 µG/L		NITRATE AS N (Cadmium Reduction Method)	00620		10 MG/L			
BARIUM	01009		1000 µG/L		PRESERVATION GROUP G <b>077</b>						
CADMIUM	01027		10 µG/L		PARAMETER	TOTAL	MG/L	MAX LEV ALLWD			
CHROMIUM	01034		50 µG/L		FLUORIDE	00951		See table in APR 1984-86			
LEAD	01051		50 µG/L		TURBIDITY	00076	Units	1 Unit			
MERCURY	71900		2 µG/L		<b>Grp E Phenols &lt;10 MG/L</b>						
SELENIUM	01147		10 µG/L								
SILVER	01077		50 µG/L								
B. OTHER ANALYSES											
PRESERVATION GROUP F				PRESERVATION GROUP G							
PARAMETER	TOTAL	µG/L	PARAMETER	TOTAL	MG/L	PARAMETER	TOTAL	MG/L			
COPPER	01042		Acidity, Mineral As CaCO <sub>3</sub>	00436		Sulfate As SO <sub>4</sub>	00945				
IRON	01045		Acidity, Total, As CaCO <sub>3</sub>	00435		Surfactants MBAS As LAS	38260				
MANGANESE	01055		Alkalinity, Phenolphth As CaCO <sub>3</sub>	00415							
ZINC	01092		Alkalinity, Total, As CaCO <sub>3</sub>	00410							
CALCIUM As Ca	00916	mg/l	Chloride	00940							
MAGNESIUM As Mg	00927	mg/l	Hardness As CaCO <sub>3</sub>	00900							
POTASSIUM	00937	mg/l	Residue, Filtrable (TDS)	00515		PRESERVATION GROUP J					
SODIUM	00929	mg/l	Residue, Non-Filtrable (SS)	00530		PARAMETER	TOTAL	MG/L			
			Residue	00500							
			Specific Conductance	00095	µmhos						
1. ORGANIZATION REQUESTING ANALYSIS  <b>Hulman Regional AIRPORT</b>						CHEMIST <b>[Signature]</b>					
						REVIEWED BY					
						APPROVED BY <b>[Signature]</b>					

H-31

8.08

2. LABORATORY PERFORMING ANALYSIS <div style="font-size: 1.5em; font-family: cursive;">OEHL</div>		3. LAB SAMPLE NUMBER <div style="font-size: 1.5em; font-family: cursive;">07877</div>		4. REQUESTOR SAMPLE NUMBER <div style="font-size: 1.5em; font-family: cursive;">GP860005</div>	
SAMPLE COLLECTION INFORMATION				5. DATE RECEIVED BY LAB <div style="font-size: 1.2em; font-family: cursive;">5 Feb. 86</div>	
7. SITE DESCRIPTION				6. DATE ANALYSIS COMPLETED <div style="font-size: 1.2em; font-family: cursive;">19 Feb. 86</div>	
				ON-SITE ANALYTICAL RESULTS	
8. SITE LOCATION NO	9. FLOWRATE AT SITE <small>00000 GAL/MIN</small>	10. WEATHER <small>00041</small>	16. WATER TEMP <small>000 10 °C</small>	17. PH <small>00400 UNITS</small>	18. DISS O <sub>2</sub> <small>00300 MG/L</small>
11. COLLECTION DATE/PERIOD			12. NAME OF COLLECTOR		
13. SAMPLING TECHNIQUE <div style="font-size: 1.2em; font-family: cursive;">FEB 5 11 34 AM '86</div>			14. PHONE NUMBER		
15. REASON FOR SAMPLE SUBMISSION					

ANALYSES REQUESTED AND RESULTS					
A. PRIMARY DRINKING WATER STANDARDS (40CFR 141)					
PRESERVATION GROUP F			PRESERVATION GROUP C		
PARAMETER	TOTAL	AL G/L	MAX LEV ALLWD	PARAMETER	TOTAL
ARSENIC	01002	L10	50 µG/L	NITRATE AS N (Cadmium Reduction Method)	00620
BARIUM	01007	248	1000 µG/L		
CADMIUM	01027	2.50	10 µG/L	FLUORIDE	00951
CHROMIUM	01034	L50	50 µG/L	TURBIDITY	00076
LEAD	01051	L20	50 µG/L		
MERCURY	71900	L1	2 µG/L		
SELENIUM	01147	L10	10 µG/L		
SILVER	01077	L10	50 µG/L		

B. OTHER ANALYSES								
PRESERVATION GROUP F				PRESERVATION GROUP G				
PARAMETER	TOTAL	MG/L	PARAMETER	TOTAL	MG/L	PARAMETER	TOTAL	MG/L
COPPER	01042	30	Acidity, Mineral As CaCO <sub>3</sub>	00436		Sulfate As SO <sub>4</sub>	00945	
IRON	01045	499	Acidity, Total As CaCO <sub>3</sub>	00435		Surfactants MBAS As LAS	38260	
MANGANESE	01055	150	Alkalinity, Phenolphthalein As CaCO <sub>3</sub>	00415				
ZINC	01092	165	Alkalinity, Total As CaCO <sub>3</sub>	00410				
CALCIUM As Ca	00916	450	Chloride	00940				
MAGNESIUM As Mg	00927	22.1	Hardness As CaCO <sub>3</sub>	00900	200			
POTASSIUM	00937	ME	Residue, Filtrable (TDS)	00515		PRESERVATION GROUP J		
SODIUM	00929	ME	Residue, Non-Filtrable (SS)	00530		PARAMETER		
Muchel		150	Residue	00500				
			Specific Conductance	00095	µmhos			

1. ORGANIZATION REQUESTING ANALYSIS  
 + Calcium = 43.8 mg/L  
 + Magnesium = 22.1 mg/L

Hulman Regional AIRPORT

CHEMIST  

E.H. HATH

REVIEWED BY

APPROVED BY

D. J. Bird

H-32

2. LABORATORY PERFORMING ANALYSIS <div style="font-size: 1.5em; text-align: center;">OEH</div>		3. LAB SAMPLE NUMBER <div style="font-size: 1.5em; text-align: center;">07878</div>		4. REQUESTOR SAMPLE NUMBER <div style="font-size: 1.5em; text-align: center;">GP860006</div>	
SAMPLE COLLECTION INFORMATION				5. DATE RECEIVED BY LAB 5 Feb. 85	
7. SITE DESCRIPTION				6. DATE ANALYSIS COMPLETED 19 Feb. 85	
8. SITE LOCATION NO		9. FLOWRATE AT SITE 00089 GAL/MIN		10. WEATHER 00061	
11. COLLECTION DATE/PERIOD		12. NAME OF COLLECTOR		13. RESULTS OF OTHER ON-SITE ANALYSES	
12. SAMPLING TECHNIQUE FEB 5 11 34 AM '85		14. PHONE NUMBER			
15. REASON FOR SAMPLE SUBMISSION					

ANALYSES REQUESTED AND RESULTS							
A. PRIMARY DRINKING WATER STANDARDS (40CFR 141)							
PRESERVATION GROUP F				PRESERVATION GROUP C			
PARAMETER	TOTAL	µ G/L	MAX LEV ALLWD	PARAMETER	TOTAL	MG/L	MAX LEV ALLWD
ARSENIC	01002		50 µ G/L	NITRATE AS N (Cadmium Reduction Method)	00620		10 MG/L
BARIUM	01007		1000 µ G/L				0.5
CADMIUM	01027		10 µ G/L	FLUORIDE +	00951	0.8	See table in AFR 161-44
CHROMIUM	01034		50 µ G/L	TURBIDITY	00076	2 Units	1 Unit
LEAD	01051		50 µ G/L				
MERCURY	71900		2 µ G/L				
SELENIUM	01147		10 µ G/L				
SILVER	01077		50 µ G/L				

PRESERVATION GROUP F			PRESERVATION GROUP G					
PARAMETER	TOTAL	µG/L	PARAMETER	TOTAL	MG/L	PARAMETER	TOTAL	MG/L
COPPER	01042		Acidity, Mineral As CaCO <sub>3</sub>	00436		Sulfate As SO <sub>4</sub>	00945	7
IRON	01045		Acidity, Total As CaCO <sub>3</sub>	00435		Surfactants MBAS As LAS	38260	
MANGANESE	01055		Alkalinity, Phenolphth As CaCO <sub>3</sub>	00415		color		25
ZINC	01092		Alkalinity, Total As CaCO <sub>3</sub>	00410				
CALCIUM As Ca	00916	mg/l	Chloride	00940	4			
MAGNESIUM as Mg	00927	mg/l	Hardness As CaCO <sub>3</sub>	00900				
POTASSIUM	00937	mg/l	Residue, Filtrable (TDS)	00515		PRESERVATION GROUP J		
SODIUM	00929	mg/l	Residue, Non-Filtrable (SS)	00530		PARAMETER		
			Residue	00500				
			Specific Conductance	00095	µmhos			

1. ORGANIZATION REQUESTING ANALYSIS

+ Fluoride = 0.8 MG/L

*Hulman Regional AIRPORT*

H-33

CHEMIST

REVIEWED BY

APPROVED BY



LABORATORY ANALYSIS REPORT AND RECORD (General)				DATE 3 MAR 1986							
VOLUME		FROM DSAF OCHL/BAH Brooks AFB TX 78235-5501									
SAMPLE IDENTITY <i>potable water</i>		DATE RECEIVED 5 Feb. 86									
SAMPLE FROM		LAB CONTROL NO <i>See below</i>									
TEST FOR <i>primary drinking water standards for pesticides &amp; o-c screen</i>											
METHOD/DOLOGY Gas Chromatography											
RESULTS  SAMPLE ANALYZED FOR	Quantitative Detection Limit (1 liter sample) Micrograms/Liter (parts per Billion)	LAP CONTROL NUMBER - BASE CONTROL NUMBER Concentration in 1 Liter Sample - Micrograms/Liter									
		07879 GP860007	07880 GP860007								
Aldrin	.02	X									
DDO	.02	X									
DDT	.02	X									
Dieldrin	.02	X									
Endrin	.02	X									
Heptachlor	.02	X									
Heptachlorepoide	.02	X									
Lindane	.01	X									
P,P'-DDT	.02	X									
Diazinon	.02										
Malathion	.10										
Parathion	.02										
Methoxychlor	.20	X									
o,p'-DDT	.02	X									
Chlordane	.20	X									
alpha-BHC	.01	X									
beta-BHC	.02	X									
delta-BHC	.02	X									
Toxaphene	1.0										
2,4-D	0.06										
Silvex	0.06										
2,4,5-T	0.06										

REMARKS 7880 Cancelled per telcom of TSgt Woodworth 14R686 DED

••T• means less than the quantitative detection limit (Trace present).

••X• means less than the qualitative detection limit (none detected).

*Denise L. Mark*  
chemist

181 TAC Clinic / 5GPB

Hulman Regional Airport, Terre Haute

IA 47802-5300

YOSHIMI A. NISHIOKA, Chemist

YOSHIMI A. NISHIOKA, GS-12

Pesticides Analysis Function

Environmental Chemistry Branch

1. LABORATORY PERFORMING ANALYSIS			3. LAB SAMPLE NUMBER 054713			4. REQUESTOR SAMPLE NUMBER <b>GP860032</b>		
SAMPLE COLLECTION INFORMATION			5. DATE RECEIVED BY LAB 15 Aug. 86			6. DATE ANALYSIS COMPLETED 20 Aug. 86		
7. SITE DESCRIPTION			ON-SITE ANALYTICAL RESULTS					
8. SITE LOCATION NO.		9. FLOW RATE AT SITE 00088 GAL/MIN		10. WEATHER		11. WATER TEMP 17. PM		12. DISEASE
11. COLLECTION DATE/PERIOD		12. NAME OF COLLECTOR		13. RESULTS OF OTHER ON-SITE ANALYSES				
13. SAMPLING TECHNIQUE		14. PHONE NUMBER						
15. REASON FOR SAMPLE SUBMISSION								
ANALYSES REQUESTED AND RESULTS								
A. PRIMARY DRINKING WATER STANDARDS (40CFR 141)								
PRESERVATION GROUP F				PRESERVATION GROUP C				
PARAMETER	TOTAL	$\mu\text{G/L}$	MAX LEV ALLOWD	PARAMETER	TOTAL	MG/L	MAX LEV ALLOWD	
ARSENIC	01002	.	50 $\mu\text{G/L}$	NITRATE AS N (Cadmium Reduction Method)	00620	.	10 MG/L	(23)
BARIUM	01007	.	1000 $\mu\text{G/L}$	PRESERVATION GROUP G				
CADMIUM	01027	.	10. $\mu\text{G/L}$	PARAMETER	TOTAL	MG/L	MAX LEV ALLOWD	
CHROMIUM	01034	.	50 $\mu\text{G/L}$	FLUORIDE	00951	.	See table in AFR 161-44	
LEAD	01051	.	50 $\mu\text{G/L}$	TURBIDITY	00076	Units	1 Unit	
MERCURY	71900	.	2 $\mu\text{G/L}$	(GPR B) OIL & GREASE		<0.3		
SELENIUM	01147	.	10 $\mu\text{G/L}$					
SILVER	01077	.	50 $\mu\text{G/L}$					
B. OTHER ANALYSES								
PRESERVATION GROUP F			PRESERVATION GROUP G					
PARAMETER	TOTAL	$\mu\text{G/L}$	PARAMETER	TOTAL	MG/L	PARAMETER	TOTAL	MG/L
COPPER	01042	.	Acidity, Mineral As $\text{CaCO}_3$	00436	.	Sulfate As $\text{SO}_4$	00945	.
IRON	01045	.	Acidity, Total, As $\text{CaCO}_3$	00435	.	Surfactants MBAS As LAS	38260	.
MANGANESE	01055	.	Alkalinity, Phenolphthalein As $\text{CaCO}_3$	00435	.			
ZINC	01092	.	Alkalinity, Total, As $\text{CaCO}_3$	00435	.			
CALCIUM As Ca	00916	mg/l	Chloride	00940	.			
MAGNESIUM as Mg	00927	mg/l	Hardness As $\text{CaCO}_3$	00900	.			
POTASSIUM	00937	mg/l	Residue, Filtrable (TDS)	00515	.	PRESERVATION GROUP J		
SODIUM	00929	mg/l	Residue, Non-Filtrable (SS)	00530	.	PARAMETER		
			Residue	00500	.			
			Specific Conductance	00095	$\mu\text{mhos}$			
1. ORGANIZATION REQUESTING ANALYSIS				CHEMIST				
<i>Hulman Field</i>				REVIEWED BY				
				APPROVED BY				
				<i>D. J. R. D.</i>				

H-35

ENVIRONMENTAL SAMPLING DATA				OEHL USE ONLY	
(Use this space for mechanical imprint)				SAMPLING SITE IDENTIFIER (AFR 19-7) <b>0345 PL 100</b> BASE WHERE SAMPLE COLLECTED <b>H. L. Lee Field TN ANG</b> SAMPLING SITE DESCRIPTION <b>Underground 1 cell, Bldg. 97</b> COLLECTION METHOD <input checked="" type="checkbox"/> GRAB <input type="checkbox"/> COMPOSITE    HOURS	
DATE COLLECTION BEGAN (YYMMDD) <b>8/6/08 1113</b>		TIME COLLECTION BEGAN (24 hour clock) <b>0930</b>			
MAIL REPORTS TO (circle if changed)	ORIGINAL	<b>0345 Yet TAG Clinic/SGPB, Hattiesburg Regional Airport, Terre Haute, IN 47803</b>			
	COPY 1				
	COPY 2				
SAMPLE COLLECTED BY (Name, Grade, AFSC) <b>C Woodworth, TSgt, 90770</b>				SIGNATURE <b>Charles J. Woodworth</b> AUTOVON <b>724-1308</b>	
REASON FOR SUBMISSION <input checked="" type="checkbox"/> A-ACCIDENT/INCIDENT <input type="checkbox"/> R-ROUTINE/PERIODIC		C-COMPLAINT N-NPDES		F-FOLLOWUP/CLEANUP O-OTHER (specify)	
BASE SAMPLE NUMBER <b>6P 86 0032</b>				OEHL PID	
ANALYSES REQUESTED (Check appropriate blocks)					
GROUP A		Hardness 00900		Silica 00955	
Ammonia 00610		Iron 01045		2, 4, 5-T 39740	
Chemical Oxygen Demand 00340		Lead 01051		Specific Conductance 00095	
Kjeldahl Nitrogen 00625		Magnesium 00927		Sulfate 00945	
Nitrate 00620		Manganese 01055		Surfactants-MBAS 38260	
Nitrite 00615		Mercury 71900		Turbidity 00076	
Oil & Grease 00560		Nickel 01067			
Organic Carbon 00680		Potassium 00937			
Orthophosphate 00671		Selenium 01147		GROUP H	
Phosphorus, Total 00665		Silver 01077		Aldrin 39330	
		Sodium 00929		BHC Isomers 39340	
GROUP D		Thallium 01059		a-BHC 39337	
Cyanide, Total 00720		Zinc 01092		b-BHC 39338	
Cyanide, Free 00722				d-BHC 34259	
				Chlordane 39350	
GROUP E		GROUP G		GROUP I	
Phenols 32730		Acidity, Total 70508		DDT Isomers 39370	
		Alkalinity, Total 00410		p, p-DDD 39310	
		Alkalinity, Bicarbonate 00425		p, p-DDE 39320	
GROUP F		Antimony 01097		p, p-DDT 39300	
Arsenic 01002		Bromide 71870		Dieldrin 39380	
Barium 01007		Carbon Dioxide 00405		Dursban 77969	
Beryllium 01012		Chloride 00940		Endrin 39390	
Boron 01022		Color 00080		Heptachlor 39410	
Cadmium 01027		Fluoride 00951		Heptachlor Epoxide 39420	
Calcium 00916		Residue, Total 00500		Lindane 39782	
		Residue, Filterable (TDS) 70300		Methoxychlor 39480	
Chromium, Total 01034		Residue, Nonfilterable 00530		Pramitol (Prameton) XY4200000	
Chromium VI 01032		Residue, Settleable 50085		Toxaphene 39400	
Copper 01042		Residue, Volatile 00505		2, 4-D 39730	
ON SITE ANALYSES					
				PARAMETER	VALUE
				Flow	50050 mgd
				Chlorine, Total	50060 mg/l
				Dissolved Oxygen	00300 mg/l
				pH	00400 7.4 units
				Temperature	00010 °C
				Odor	00086
				Iodide	71865
				Sulfite	00740
REMARKS <b>Original Sample - Damaged,</b>					